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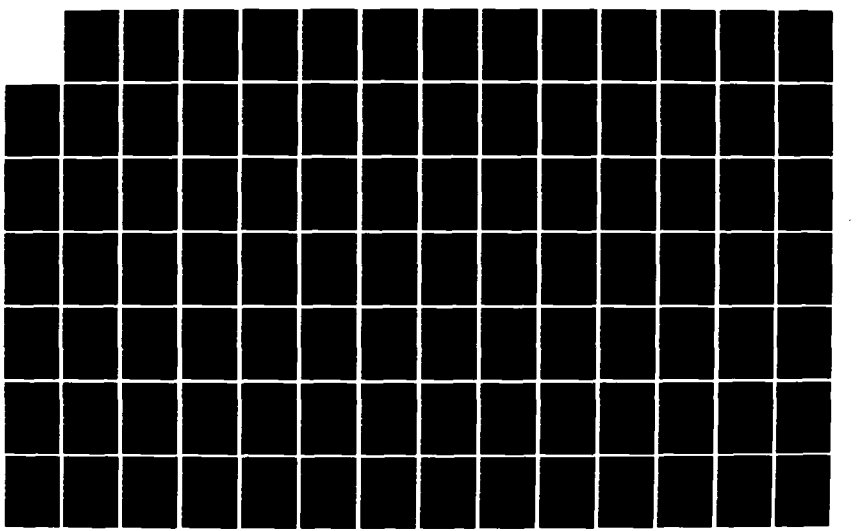

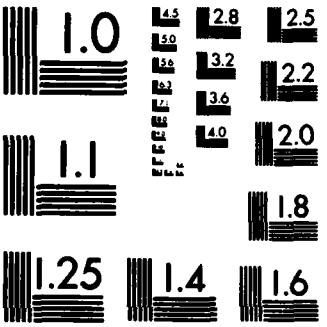

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CORDIVEM EUROPEAN TERRAIN DATA

Technical Paper 2-83

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Technical Paper 2-83

Combined Arms Operations Research Activity
Fort Leavenworth, Kansas 66027

CORDIVEM EUROPEAN TERRAIN DATA

by

WALTER J. THOMSON

ACN 23440

Approved by:

DAVID J. FARMER
Director, TSSD

JOHN L. BALLANTYNE
Brigadier General, USA
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ABSTRACT

The CORDIVEM combat simulation model requires large amounts of terrain data for successful modelling of corps and division level processes. As of March 1982 the terrain data was limited to the usual Fulda Gap area of the Federal Republic of Germany (FRG). This document describes the data sources and the methods used to develop a corps-sized European terrain data base for the Corps - Division Evaluation Model.

TABLE OF CONTENTS

MAIN REPORT

1. Background.

a. CORDIVEM requirements.

(1) Operational data. When purchased from BDM, the model ran - and still runs - on hexagonal cells (hexes) of terrain data. The format of this hex data has not been changed from that of ICOR. Each hex has a 3.57 km inner diameter and contains stylized information on terrain roughness, cover and lines-of-communication (LOC, roads) and hydrography (rivers). (See appendix A.) This original hex data covers a roughly oval-shaped area centered near Fulda with a radius of 50 to 120 km. BDM Services Corporation (the developer of ICOR) produced this hex data by a visual analysis of 1:50,000 scale maps.

(2) Display data. Part of the evolution of CORDIVEM from ICOR has been the grafting of display data and software from the Corps Battle Game (CGB) effort onto the model. The display data currently being used for demonstration is the result of patching and reformatting of some special high-resolution digital products prepared by the Defense Mapping Agency (DMA). The file represents an area extending 200 km in the east-west axis and 150 km in the north-south axis centered at 32UPB00. In the display file the data is at 100m resolution with each point having a surface feature code (open, forest, urban) and an elevation value. In addition to this areal data there is a small network of roads and rivers which was digitized by CASAA personnel (now part of CAORA) using software delivered to BDM for use in their LOC/terrain analysis effort.

b. LOC/Terrain database.

(1) Background:

(a) Data sources. In December of 1979 CASAA (now part of CAORA) issued a contract to BDM Services Corporation to produce a terrain data base for the Corps Battle Game, a predecessor of CORDIVEM. Under the terms of this contract BDM was to produce digitized terrain data, loc and hydrography nets for virtually all of Germany. The form of this data was to match the previously-mentioned display data. It was to be developed using DMA elevation data, using CASAA-supplied maps, software and hardware, and the "Bundespost" data.

(b) Bundespost data. The Bundespost data was produced by the post office (Bundespost) of the Federal Republic of Germany. It was provided to Electromagnetic Compatibility Analysis Center (ECAC) in 1976. ECAC reformatted this data and forwarded a copy to TRASANA in 1979. This data contained 100m surface feature codes and elevation data for all of FRG and was the only large-scale terrain database available for Germany. Unfortunately, the data contained many inconsistencies.

(2) Areal. As part of BDM's LOC/Terrain contract the Bundespost data was obtained from TRASANA. This data was used to represent FRG while DMA elevation data was used for German Democratic Republic (East Germany) with no surface feature data.

(3) Linear. The principal effort was an analysis and digitization of the loc and hydrography network for virtually all of Germany - an area represented by about 600 1:50,000 scale maps.

(4) Final product. The final result of this effort was a database extending roughly 400 km east-to-west and 600 km north-to-south to be used as the terrain database for the CBG. The shortcomings of the areal data were recognized and it was originally intended to serve as an interim resource. Nevertheless, this is the source used in our production of operational and display data for CORDIVEM.

2. Method.

a. Preprocessing.

(1) Inspection. After reinspecting the areal data it was determined, since CORDIVEM operates on the 3.57 km hex cell, that the elevation data was accurate enough for CORDIVEM hex data use and that the surface data could be graphically emended.

(2) Editing. The objective of editing the feature data was to ensure that the areas of urban and forest code were in approximately the right location and size for incorporation into the hexes; no other factors were considered. The editing was accomplished by displaying a 20- or 40-km square (operator's choice) on a Tektronix 4027 terminal, comparing the display to a 1:50,000 scale map and making changes to the data with a "rectangular cookie-cutter" routine.

(3) Digitization. To fill part of the GDR void in the data base, the urban and forested areas from 74 1:50,000 scale maps were digitized on a Tektronix 4083 system. This data was then transferred to the VAX, reformatted and packed into the terrain data files. This data was then edited in the same fashion as the Bundespost data.

(4) Additions. The only change to the linear data was to insert end-nodes into the link records. (A link is a section of road or river and a node is an end point of this section; the original links only contained a start node with no stop.)

b. Areal data aggregation. Each hex within the area was approximated by a circle with a radius of 2,000m (the 3.57 km hex has an inner radius of 1785m on an outer radius of 2061m). Tallies were then made of the surface feature codes of the data points within this circle, and average elevation and average absolute slope were then calculated. The hex address, UTM coordinates, average elevation, percent slope and percent open, urban and forest cover were written to a file for further processing.

c. Linear data aggregation.

(1) LOC-hydrography differences. While the loc and hydrography nets are similar, they differ in function. The same is true of their more abstract representation in the hex data: the loc provides, and the hydrography impedes access from one area to another. Thus, slightly different algorithms were used for aggregating each type of data into the hex format.

(2) LOC. The road net was processed by link records. If the terminal nodes of a link were in adjacent hexes, then this connectivity was recorded in the common side of both hexes and the next link was accessed. If not, then the first subnode (essentially a subnode is a curve in the link) was accessed. If the initial node and this subnode were in adjacent hexes, then this was recorded as a hex connectivity; the subnode was then regarded as the initial node whether in the same or adjacent hex and the process iterated to completion. (The case where the subnode was in a nonadjacent hex indicated an error in the source data.)

(3) Hydrography. In converting the hydrography to hex data, each link was inspected subnode-by-subnode so that it could be approximated by hex sides.

(4) Postprocessing. In both cases the source network and the resulting hex data were graphically displayed on a Tektronix 4027 terminal for interactive correction. A subjective judgment is that less than 5 percent of the hex data was changed, so that even without editing the data would probably have been acceptable.

3. Results.

a. Extent. The area represented by the resulting data base is approximately square, it is centered at 32UNC00 and extends 400 km along each axis.

b. Format.

(1) Hex. The hex data is in a file indexed by hex address and UTM coordinates of the hex center; a user can extract a desired rectangular portion in the CORDIVEM input format by running the provided routine 'HEXOUT.'

(2) Display. Each 10 km square of areal data is stored in a file indexed by the UTM coordinate of its southwest corner (i.e., 32UNC45). The linear data is as provided by BDM except that the end node coordinates have been substituted for the seldom-used route numbers (the original data is still available).

APPENDIX A

DATA STRUCTURES AND ACCESS METHODS

APPENDIX A. Data Structure and Access Methods

1. Hex Data.

a. Location. The hex data is stored in the file HEXTERR.DAT in the save-set HEX.BCK on tape #817 in the CGF tape library.

b. File structure. HEXTERR.DAT is an indexed sequential file. The primary index being the hex address with two secondary indices - the UTM coordinates of the hex center.

c. Record structure. Each record contains 7 I*4 words as follows: hex address, easting and northing of the hexcenter (UTM), average elevation, connectivity codes, river codes and surface feature codes. The hex address is the external form; the easting, the northing and the average elevation are in meters; the connectivity and river codes are packed in descending order of sides (i.e., from side 6 to side 1); and the surface feature codes are packed in the order: urbanization, forestation, roughness.

d. Access methods.

(1) A CORDIVEM input file for a selected rectangular area can be obtained by running the routine HEXOUT, which is also in HEX.BCK.

(2) To access the file HEXTERR.DAT from a user-written routine, the file should be opened with:

```
STATUS = 'OLD'
ORG    = 'INDEXED'
ACCESS = 'KEYED'
RECL   = 7
RECORDTYPE = 'FIXED'
FORM = 'UNFORMATTED'
KEY = (1:4:INTEGER, 5:8:INTEGER,9:12:INTEGER)
SHARED, READONLY
```

Alternately, the programer can include 'HEXDAT.TYP' and 'HEXTERR.OPN' from the terrain text library on DBO: of the CGF Vax.

2. Areal data.

a. Location. Each 10 km square of surface/elevation data occupies one file in sav-set 32UDAT.BCK on tape 818 in the CGF library.

b. File structure. Each file contains one 20,000-byte record.

c. Record structure. Each record contains 10,000 I*2 words representing the 100m grid for the given 10 X 10 km area, written columnwise. The data for each point is packed as elevation* 8 + feature code.

d. Access methods. The required open statement is "OPEN (UNIT=LU,FILE=fname)" where "LU" and "fname" are the logical unit and name of the file. The required read statement is just "READ(LU) A" where A is a 100 X 100 I*2 array. If the data is placed into a 400 X 400 array (to represent a 40 km square) then the functions ICODE and IELV from the TERRAIN library may be used.

3. Linear data.

a. Location. Copies of the linear databases produced by BDM are on tape #820 in save-set VECTOR. BCK in the CGF tape library.

b. File and record structure. The following description was obtained from BDM as a clarification of their documentation. The only change here from the original documentation is that word 4 of the link record contains the y, x, coordinates of the terminus of that link.

Supplementary Notes on the Loc Data Base

These notes are intended to clarify and expand upon the technical description of the data base which was previously delivered. Questions concerning physical and logical record sizes and record structures have been specifically addressed along with a few other items which were thought to be of interest.

DATA BASE COORDINATES

Throughout the Loc-Terrain data base the rectangular coordinates of points are specified in 20 meter units offset from an easting of 9^{0} (500,000) (the central meridian of UTM zone 32) and a northing of 5,600,000 meters (relative to the equator). This implies that MGR coordinates are easily converted to data base coordinates by a simple offset and division by 20, provided that the point in question is within UTM zone 32. For points outside of this zone, the procedure used in generating the data was to translate the given UTM designation to GEOREF (Lat/long) and then convert back to UTM coordinates relative to zone 32. The routines necessary to accomplish this are included with the software delivered with the data base.

GRID INDICES

GRID (65,65) is the 10-km grid whose southwest corner lies at the origin of the data base (32UNB00). Thus if (x,y) is the data base representation of a point, then the formula I = (X+32500)/500 and J=(Y+325000)/500 (using integer division) provide the appropriate index GRID (I,J) with which to reference the data.

TYPE CODES

Data for type of node and type of link were encoded as follows:

NODES
1 - intersection of autobahns
2 - built-up area
3 - airfield
4 - open area

LINKS
1 - autobahn
2 - main road
3 - secondary road
4 - fair weather road
5 - rail line
6 - ferry
7 - ford
8 - heavy bridge
9 - dam
10 - road tunnel
11 - rail tunnel
12 - major river
13 - minor river
14 - stream

LOC DATA FILE SPECIFICATIONS

The eight LOC files have the same basic organization. They are each composed of logical records which are 500 I*4 words in length. Furthermore, each is structured as a two-dimensional array.

GRID FILES: Contain pointers to the node files

LENGTH - NEWG.DAT: 33 logical records (16500 words)
NEWHG.DAT: 33 logical records (16500 words)
ARRAY STRUCTURE - 128 X 128
POINTERS - Each entry is either 0 (indicating no data) or else it contains a pointer to the first node in the specified grid.

NODE FILES: Contain linked lists of nodes belonging to a given grid.

LENGTH - NEWN.DAT: 1845 logical records (922500 words)
NEWHN.DAT: 35 logical records (17500 words)
ARRAY STRUCTURE - 5 X N (N=100=(number of logical records))
Entry (I,J) in this array contains information about node J.
(I,J) = pointer to the next node in this linked list
(2,J) = code for this type of node
(3,J) = pointed to first link terminating at this node
(4,J) = pointer to first link originating at this node.
(5,J) = X, Y coordinates of node location (X is in the lower half word)

POINTERS - A zero entry indicates the end of a linked list

LINK FILES: Contain linked lists of inlinks and outlinks for a given node

LENGTH - NEWL.DAT:2698 logical records (1349000 words)
NEWHL.DAT:35 logical records (17500 words)
ARRAY STRUCTURE - 5 X N (N = 100*(number of logical records))
Entry (I,J) in this array contains information about link J.
(1,J) = pointer to next inlink in this linked list
(2,J) = pointer to next outlink in this linked list
(3,J) = length of this link (in 20 meter units)
(4,J) = coordinates of end node
(5,J) = pointer to list of subnodes which describe this link
POINTER - A zero entry indicates the end of a linked list except for (5,J) in which case it would imply that no subnode list is associated with this link.

SUBNODE FILES: Contain a concatenation of the subnode lists associated with links in the link files.

LENGTH - SUB.DAT:3977 logical records (1988500 words)
HSUB.DAT:299 logical records (149500 words)

ARRAY STRUCTURE 500 X N (N = number of logical records)

The array structure imposed upon this file has no direct relevance to the data stored within it. The primary function is to allow the data to be accessed by the same mechanism used by the other files. The pointers to this file from the link file are separated into a record pointer (lower half word) and a word-within-the-record pointer (upper half-word).

SUBNODE LIST STRUCTURE - The first word of a subnode list contains twice the number of subnodes in this list. If this number is N, the next N2 words contain X,Y coordinates which describe the associated link. Note that X is contained in the lower half-word.

c. Access methods.

(1) The user may use routines supplied by BDM with the LOC/terrain documentation or he may use the routines GRIDS, IGRID, GETNDS, and GETREC from the Terrain library.

(2) For accessing this data from a lower level the user is referred to BDM LOC/Terrain documentation.

APPENDIX B

SOFTWARE

APPENDIX B

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BDMEXT CALLING SEQUENCE

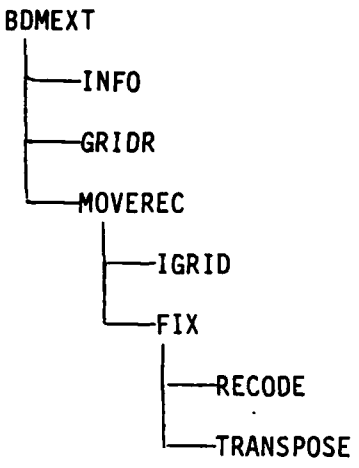


Figure B-1

PROGRAM: BDMEXT

ROUTINE \ COMMON	GRAPH	GRID
BDMEXT		X
GRIDR		X
INFO	X	
MOVEREC	X	X

Figure B-2

```
0001              PROGRAM BDMEXT
0002      ************************************************************
0003      *       THIS PROGRAM WAS ADAPTED FROM A ROUTINE WHICH      *
0004      *       ORIGINALLY DISPLAYED THE BDM LOC DATA.             *
0005      *       THIS VERSION TRANSFERS TERRAIN DATA FROM           *
0006      *       THE FILE TERUTM TO 10 KM FILES.                    *
0007      ************************************************************
0008              INTEGER*4 I,J,X,Y
0009              INCLUDE 'GRID.CMN'
0010    1 ****************************************************
0011    1 *       GRID CONTAINS THE POINTERS TO THE 10-KM    *
0012    1 *       TERRAIN RECORDS IN THE FILE TERUTM.        *
0013    1         INTEGER*2 GRID(128,128)
0014    1         COMMON/GRID/GRID
0015    1 ****************************************************
0016              CALL INFO(LUIN,LUOUT)
0017      *       READ IN GRID FILE
0018              CALL GRIDR(LUIN)
0019      *       TRANSFER THE INDICATED RECORDS FROM TERUTM TO
0020      *       THE SMALLER FILES.
0021              CALL MOVEREC(LUIN,LUOUT)
0022              END
```

```
0001            SUBROUTINE FIX(A)
0002      ********************************************************************
0003      *       THIS SUBROUTINE 'FIXES' THE ARRAY A SO THAT THE FEATURE    *
0004      *       AND ELEVATION CODES ARE REPACKED AS FEA+8*ELE AND          *
0005      *       THE ARRAY IS TRANSPOSED.                                   *
0006      ********************************************************************
0007            IMPLICIT INTEGER*2 (A-Z)
0008            DIMENSION A(100,100)
0009            DO J=1,100
0010               DO I=1,100
0011                  ICODE=ISHFT(A(I,J),-12)
0012                  IELV=A(I,J)-ISHFT(ICODE,12)
0013                  ICODE=RECODE(ICODE)
0014                  IF(IELV.LE.0.OR.IELV.EQ.4095)THEN
0015                    ICNT=ICNT+1
0016                    IELV=0
0017                  ENDIF
0018                  A(I,J)=ICODE+8*IELV
0019               ENDDO
0020            ENDDO
0021            CALL TRANSPOSE(A)
0022            RETURN
0023            END
```

```
0001            SUBROUTINE GRIDR(LUIN)
0002      ************************************************
0003      *        ROUTINE OPENS THE FILE 'TERUTM' AND   *
0004      *        READS THE GRID RECORDS.               *
0005      ************************************************
0006            INCLUDE 'GRID.CMN'
0007    1 ************************************************
0008    1 *        GRID CONTAINS THE POINTERS TO THE 10-KM *
0009    1 *        TERRAIN RECORDS IN THE FILE TERUTM.     *
0010    1         INTEGER*2 GRID(128,128)
0011    1         COMMON/GRID/GRID
0012    1 ************************************************
0013      ************************************************
0014            OPEN(ACCESS='DIRECT',ASSOCIATEVARIABLE=IAV,
0015           +     BLOCKSIZE=20008,FORM='UNFORMATTED',
0016           +     MAXREC=90000,NAME='DB1:[WALTER]TERUTM.DAT',
0017           +     RECORDSIZE=5002,RECORDTYPE='FIXED',
0018           +     TYPE='OLD',UNIT=LUT,EXTENDSIZE=1,SHARED)
0019      ************************************************
0020            READ(LUIN'1)((GRID(I,J),I=1,128),J=1,64)
0021            READ(LUIN'2)((GRID(I,J),I=1,128),J=65,128)
0022            OPEN(NAME='STATS',TYPE='NEW',UNIT=3)
0023          RETURN
0024          END
```

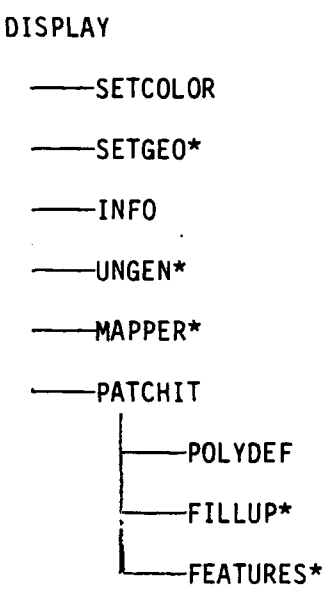
```
0001              SUBROUTINE INFO(LUIN,LUOUT)
0002        ************************************************
0003        *        PROMPTS THE USER FOR NECESSARY INFO   *
0004        ************************************************
0005              INCLUDE 'GRAPH.CMN'
0006      1 ************************************************
0007      1 *        THE MIN AND MAX COORDINATE VALUES      *
0008      1         COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT
0009      1 ************************************************
0010              PRINT*,'ENTER THE EASTING AND NORTHING OF THE SW CORNER'
0011              READ*,XMIN,YMIN
0012              PRINT*,'NOW ENTER THE EXTENTS, AGAIN IN METERS.'
0013              PRINT*,'EASTING:'
0014              READ*,XINT
0015              PRINT*,'NORTHING:'
0016              READ*,YINT
0017              XMAX=XMIN+XINT
0018              PRINT*,'ENTER THE LOGICAL UNIT NUMBER OF THE INPUT FILE'
0019              READ*,LUIN
0020              PRINT*,'ENTER THE LOGICAL UNIT NUMBER OF THE OUTPUT FILE'
0021              READ*,LUOUT
0022              YMAX=YMIN+YINT
0023              RETURN
0024              END
```

```
0001              SUBROUTINE MOVEREC(LUIN,LUOUT)
0002     ******************************************************
0003     *        THIS SUBROUTINE IS DESIGNED TO MOVE DESIGNATED  *
0004     *        RECORDS FROM THE FILE 'TERUTM.DAT' TO 10KM      *
0005     *        FILES.                                          *
0006     ******************************************************
0007     *        INPUTS:  LUIN,LUOUT--LOGICAL UNIT NUMBERS       *
0008     ******************************************************
0009              INTEGER*2 BUFR(10004),SQUARE(100,100)
0010              CHARACTER*7 MGR
0011              LOGICAL*1 ERR
0012              INTEGER*4 X,Y,I,J
0013              INCLUDE 'GRAPH.CMN'
0014    1 ************************************************
0015    1 *        THE MIN AND MAX COORDINATE VALUES       *
0016    1         COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT
0017    1 ************************************************
0018              INCLUDE 'GRID.CMN'
0019    1 ************************************************
0020    1 *        GRID CONTAINS THE POINTERS TO THE 10-KM *
0021    1 *        TERRAIN RECORDS IN THE FILE TERUTM.     *
0022    1         INTEGER*2 GRID(128,128)
0023    1         COMMON/GRID/GRID
0024    1 ************************************************
0025              EQUIVALENCE (BUFR(5),SQUARE(1,1))
0026     C...     FOR EACH GRID
0027     C...     10KM ARE SUBTRACTED TO INDICATE THE SW CORNER OF
0028     C...     THE LAST BLOCK.
0029              DO X=XMIN,XMAX-10000,10000
0030     C...        DISTANCES ARE MEASURED IN UNITS OF 20 METERS FROM
0031     C...        AN ORIGIN OF 5000000M N, 5600000M E.  THE ORIGIN
0032     C...        CORRESPONDS TO  GRID INDICES OF (65,65) IN TERUTM.
0033     C
0034                    DO Y=YMIN,YMAX-10000,10000
0035                         CALL IGRID(X,Y,I,J)
0036 C   D                   PRINT*,GRID(I,J),I,J
0037                         IF(GRID(I,J).NE.0)THEN
0038                           READ(LUIN'GRID(I,J))(BUFR(K),K=1,10004)
0039                           CALL FIX(SQUARE)
0040                           CALL UTM2MGR(X,Y,MGR,ERR)
0041                           OPEN(UNIT=LUOUT,NAME=MGR,STATUS='NEW',FORM='UNFORM
0042                           WRITE(LUOUT)SQUARE
0043                           CLOSE(UNIT=LUOUT)
0044                           PRINT*,MGR,X,Y
0045                         ENDIF
0046                         WRITE(3,*)MGR
0047 C   D                   WRITE(3,*)(BUFR(K),K=1,4)
0048 C   D                   WRITE(3,*)'GRID(1,J)',GRID(I,J)
0049 C   D                   WRITE(3,*) ' '
0050 C   D                   PRINT*,X,Y
0051                    ENDDO
0052              ENDDO
0053              RETURN
0054              END
```

```
0001            FUNCTION RECODE(I)
0002      ************************************************************
0003      *       THIS FUNCTION TRANSLATES THE 13                    *
0004      *       CODES USED IN THE BDM TERDTM FILE INTO THE 3       *
0005      *       CODES USED IN THE CORDIVEM TERRAIN DISPLAY FILE.   *
0006      ************************************************************
0007      *       INPUTS: I-- THE OLD CODE                           *
0008      *       OUTPUTS: RECODE-- THE NEW ONE                      *
0009      ************************************************************
0010            IMPLICIT INTEGER*2(A-Z)
0011            IF(I.EQ.0)THEN
0012             I=4
0013      *      NO DATA                                            *
0014            ELSE
0015             IF(I.EQ.1.OR.I.EQ.2)THEN
0016              I=2
0017      *       URBAN                                             *
0018             ELSE
0019              IF(I.GE.3.AND.I.LE.5)THEN
0020               I=1
0021      *        FOREST                                           *
0022              ELSE
0023      *         OPEN=7,HEATH/BRUSH=6 ARE UNCHANGED              *
0024                IF(I.EQ.8)THEN
0025                 I=3
0026      *          MARSH                                          *
0027                ELSE
0028                 IF(I.EQ.9)THEN
0029                  I=5
0030      *           WATER                                         *
0031                 ELSE
0032                  IF(I.GT.9)THEN
0033                   I=4
0034      *            BAD DATA IS NO DATA                         *
0035                  ENDIF
0036                 ENDIF
0037                ENDIF
0038              ENDIF
0039             ENDIF
0040            ENDIF
0041            RECODE=1
0042            RETURN
0043            END
```

```
0001            SUBROUTINE TRANSPOSE(A)
0002    ************************************************************
0003    *       TRANSPOSES A 100*100 WORD I*2 MATRIX                *
0004    C************************************************************
0005            INTEGER*2 A(100,100),B(100,100)
0006            DO J=1,100
0007                DO I=1,100
0008                   B(I,J)=A(J,I)
0009                ENDDO
0010            ENDDO
0011            DO J=1,100
0012               DO I=1,100
0013                  A(I,J)=B(I,J)
0014               ENDDO
0015            ENDDO
0016            END
```

DISPLAY CALLING SEQUENCE



*TERRAIN SYSTEM UTILITIES

Figure B-3.

PROGRAM: DISPLAY

ROUTINES \ COMMON	ANSWER	CMERID	CORNER	MAP	WINDOW
FEATURES			X		X
FILLUP			X	X	X
INFO	X		X		X
MAPPER	X			X	X
PATCHIT			X		
SETGEO		X			
UNGEN			X		

Figure B-4.

```
0001            PROGRAM DISPLAY
0002    ********************************************************
0003    *       THIS ROUTINE DISPLAYS THE CURDIVEM DISPLAY      *
0004    *       DATA IN 40KM SQUARES.                           *
0005    ********************************************************
0006
0007            CHARACTER*1 ANS
0008            CALL SETCOLOR
0009            CALL SETGEO
0010
0011    11      CONTINUE
0012            CALL INFO
0013            CALL UNGEN
0014            CALL MAPPER
0015            CALL CMCLOS
0016            PRINT*,'CORRECTIONS TO FEATURES?'
0017            READ(5,10) ANS
0018    10      FORMAT(1A1)
0019            CALL CMOPEN
0020            IF (ANS.EQ.'Y')THEN
0021               CALL PATCHIT(ANS)
0022            ENDIF
0023            GOTO11
0024            END
```

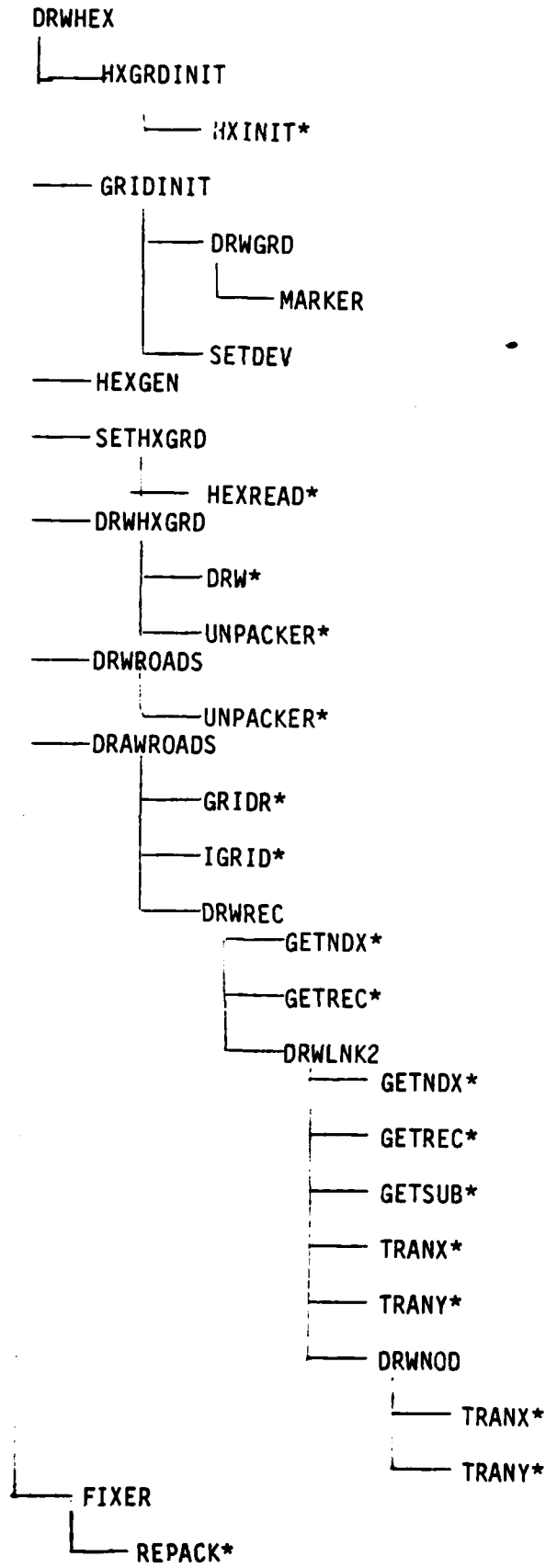
```
0001            SUBROUTINE INFO
0002      ****************************************************************
0003      *       THIS ROUTINE JUST QUERIES THE OPERATOR AS TO WHICH      *
0004      *       DISPLAYS HE WANTS.                                      *
0005      ****************************************************************
0006            IMPLICIT INTEGER*2 (I-N)
0007            INCLUDE 'WINDO.CMN'
0008    1 ****************************************************************
0009    1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND     *
0010    1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER      *
0011    1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS    *
0012    1 *       THE CONTOUR INTERVAL.                                   *
0013    1 ****************************************************************
0014    1       DIMENSION FWINXY(4)
0015    1       COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0016    1 ****************************************************************
0017            INCLUDE 'ANSWER.CMN'
0018    1 ************************************************
0019    1       CHARACTER*1 FEA,CON
0020    1       COMMON/ANSWER/FEA,CON
0021    1 ************************************************
0022            INCLUDE 'CORNER.CMN'
0023    1 ****************************************************************
0024    1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE        *
0025    1 *       AREA IN THE ARRAY IBUF.                                 *
0026    1       INTEGER*4 SWX,SWY
0027    1       COMMON/CORNER/SWX,SWY
0028    1 ****************************************************************
0029            PRINT*,'ENTER THE COORDINATES OF THE SW CORNER '
0030            READ*,SWX,SWY
0031            FWINXY(1)=SWX
0032            FWINXY(2)=FWINXY(1)+40000
0033            FWINXY(3)=SWY
0034            FWINXY(4)=FWINXY(3)+40000
0035            PRINT*,'FEATURES?'
0036      10    FORMAT(A1)
0037            READ(5,10) FEA
0038            PRINT*,'CONTOURS'
0039            READ(5,10)CON
0040            IF(CON.EQ.'Y')THEN
0041              PRINT*,'CONTOUR INTERVAL?'
0042              READ*,ZDELT
0043            ENDIF
0044            RETURN
0045            END
```

```
0001              SUBROUTINE PATCHIT(ANSWER)
0002     ************************************************
0003     *        A KLUDGE TO PASS DATA FROM POLYDEF TO FILLUP *
0004     ************************************************
0005              INCLUDE 'CORNER.CMN'
0006    1 ************************************************************
0007    1 *        SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE  *
0008    1 *        AREA IN THE ARRAY IBUF.                           *
0009    1         INTEGER*4 SWX,SWY
0010    1         COMMON/CORNER/SWX,SWY
0011    1 ************************************************************
0012              INTEGER*2 ICLR,INCR
0013              DIMENSION POLY(500,2)
0014              CHARACTER*1 ANSWER
0015              DO WHILE(ANSWER.EQ.'Y')
0016                  PRINT*,'COLOR?'
0017                  READ*,ICLR
0018                  CALL CMOPEN
0019                  CALL POLYDEF(N,POLY,ICLR)
0020                  DO I=1,N
0021                     POLY(I,1)=POLY(I,1)-SWX
0022                     POLY(I,2)=POLY(I,2)-SWY
0023                  ENDDO
0024                  CALL FILLUP(N,POLY,ICLR)
0025                  INCR=1
0026                  CALL FEATURES(INCR)
0027                  CALL CMCLOS
0028                  PRINT*,'ANOTHER PATCH?'
0029     10           FORMAT(A1)
0030                  READ(5,10) ANSWER
0031              ENDDO
0032              CALL GEN
0033              RETURN
0034              END
```

```
0001            SUBROUTINE POLYDEF(I,VERTEX,ICLR)
0002      ************************************************************
0003      *       THIS SUBROUTINE DISPLAYS A USER-DEFINED POLYGON,     *
0004      *       AND RECORDS THE COORDINATES OF THE VERTICES IN       *
0005      *       THE ARRAY VERTEX. NO MORE THAN 500 EDGES ARE ALLOWED. *
0006      ************************************************************
0007      *       INPUTS: ICLR-- THE LINE COLOR TO BE USED; 0-7        *
0008      *       OUTPUTS: VERTEX-- THE ARRAY OF VERTICES              *
0009      *                I-- THE NUMBER OF VERTICES                  *
0010      ************************************************************
0011            INTEGER*2 ICLR
0012            INTEGER*4 IMAXPT,IPT,IRET
0013            DIMENSION VERTEX(500,2)
0014            DATA IMAXPT/1/
0015            CALL CMCLOS
0016            PRINT*,'TERMINATE POLYGON DEFINITION BY ENTERING 0 AT
0017           +  THE LAST VERTEX.'
0018            CALL CMOPEN
0019            CALL LINCLR(ICLR)
0020      C
0021            I=1
0022            DO WHILE (I.LT.500)
0023               CALL LOCATE(IMAXPT,PX,PY,IRET,IPT)
0024               IF(I.GT.1)THEN
0025                 CALL MOVE(VERTEX(I-1,1),VERTEX(I-1,2))
0026                 CALL DRAW(PX,PY)
0027               ENDIF
0028               VERTEX(I,1)=PX
0029               VERTEX(I,2)=PY
0030               IF(IRET.EQ.48)THEN !ASCII 0
0031                 CALL DRAW(VERTEX(1,1),VERTEX(1,2))
0032                 I=I+1
0033                 VERTEX(I,1)=VERTEX(1,1)
0034                 VERTEX(I,2)=VERTEX(1,2)
0035                 CALL CMCLOS
0036                 RETURN
0037               ENDIF
0038               I=I+1
0039            ENDDO
0040            END
```

```
0001            SUBROUTINE SETCOLOR
0002      ************************************************
0003      *        SETS COLORS AND SPECIFIES THE         *
0004      *        TEKTRONIX 4027 AS THE GRAPHICS DEVICE *
0005      ************************************************
0006            DIMENSION BLUE(3)
0007            REAL LTBLUE(3),LTGREEN(3)
0008            DIMENSION GREEN(3),BKGRND(3),RED(3),BLACK(3)
0009            DIMENSION YELLOW(3)
0010            DATA YELLOW/100.,100.,0./
0011            DATA GREEN/20.,60.,5./,BKGRND/30.,30.,30./
0012            DATA RED/30.,10.,10./,BLACK/0.,0.,0./
0013            DATA BLUE/0.,0.,100./,LTGREEN/30.,80.,30./,
0014           +  LTBLUE/0.,70.,100./
0015      C
0016            IDEVICE=4027
0017            IOPI=5
0018           CALL GRSTRT(IDEVICE, IOPT)
0019            CALL CLRMAP(0,1,YELLOW)
0020            CALL CLRMAP(1,1,GREEN)
0021            CALL CLRMAP(2,1,RED)
0022            CALL CLRMAP(3,1,LTBLUE)
0023            CALL CLRMAP(4,1,BLACK)
0024            CALL CLRMAP(5,1,BLUE)
0025            CALL CLRMAP(6,1,LTGREEN)
0026            CALL CLRMAP(7,1,BKGRND)
0027            CALL BKGCLR(7)
0028      C
0029           RETURN
0030           END
```

DRWHEX CALLING SEQUENCE



* TERRAIN SYSTEM UTILITIES

Figure B-5.

PROGRAM: DRWHEX

ROUTINE \ COMMON	DISPLAY	GRAPH	HEX	HXGRD	HXSTOR	LNKNOD	PACK	SUB	TYPE	UNPACK
DRAWROADS						X				
DRW				X						
DRWGRD		X								
DRWHEX		X	X		X				X	
DRWHXGRD				X	X				X	X
DRWLNK2						X	X		X	
DRWREC						X				
DRWROADS				X	X	X				X
FIXER		X					X		X	
GETSUB						X		X		
GRIDINIT	X	X								
GRIDR						X				
HXGRDINIT	X		X	X						
MARKER		X								
REPACK										X
SETDEV		X								
SETHXGRD	X			X						
UNPACKER										X

Figure B-6.

```
0001            SUBROUTINE DRWNOD(NOD)
0002    ************************************************
0003    *       THIS ROUTINE EXTRACTS THE XY COORDINATES  *
0004    *       OF THE TERMINUS AND DRAWS FROM THE LAST   *
0005    *       SUBNODE TO THE TERMINUS.                  *
0006    ************************************************
0007    *       INPUTS: NOD--THE PACKED YX COORDINATES    *
0008    ************************************************
0009            INTEGER*4 NOD,TMPNOD
0010            INTEGER*2 X,Y
0011            CALL CMOPEN
0012    *       SET X COORDINATE              *
0013            TMPNOD=LIBSEXTZV(0,16,NOD)
0014            CALL LIBSINSV(TMPNOD,0,16,X)
0015    *       SET Y COORDINATE              *
0016            TMPNOD=LIBSEXTZV(16,16,NOD)
0017            CALL LIBSINSV(TMPNOD,0,16,Y)
0018    *       DRAW TO THE END NODE          *
0019            CALL DRAW(TRANX(X),TRANY(Y))
0020            CALL CMCLOS
0021            RETURN
0022            END
```

```
0001              SUBROUTINE DRWREC(HDNODE)
0002     ************************************************************
0003     *        THIS ROUTINE DRAWS THE ROADNET FOR ONE 10-KM      *
0004     *        SQUARE.                                           *
0005     ************************************************************
0006     *        INPUTS: HDNODE-- THE FIRST NODE POINTER FOR       *
0007     *                         THIS 10-KM SQUARE                *
0008     ************************************************************
0009              INTEGER*4 HDNODE,TMPNOD,NXTNOD
0010              INTEGER*2 X,Y,WRDPOS
0011              INCLUDE 'UTIL:LNKNOD.CMN'
0012    1 ************************************************************************
0013    1 *        ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES                *
0014    1 ************************************************************************
0015    1         INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0016    1         COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0017    1       + ,SUBREC(500)
0018    1 ************************************************************************
0019              NXTNOD=HDNODE
0020              DO WHILE (NXTNOD.NE.0)
0021     *           GET NODE RECORD       *
0022                CALL GETNDX(NXTNOD,NRECNUM,WRDPOS)
0023                LU=2
0024                CALL GETREC(LU,NRECNUM,NODREC)
0025                INCLUDE 'SETXY.FOR'
0026    1 C
0027    1 C       SET X COORDINATE
0028    1                TMPNOD=LIBSEXTZV(0,16,NODREC(5,WRDPOS))
0029    1                CALL LIBSINSV(TMPNOD,0,16,X)
0030    1 C       SET Y COORDINATE
0031    1                TMPNOD=LIBSEXTZV(16,16,NODREC(5,WRDPOS))
0032    1                CALL LIBSINSV(TMPNOD,0,16,Y)
0033    1 C
0034                   NXTLNK=NODREC(4,WRDPOS)
0035                   DO WHILE (NXTLNK.NE.0)
0036     *               DRWLNK2 DRAWS ONE 'OUTLINK' AND *
0037     *               GETS THE NEXT LINK POINTER      *
0038                     CALL DRWLNK2(X,Y,NXTLNK)
0039                   ENDDO
0040                   NXTNOD=NODREC(1,WRDPOS)
0041              ENDDO
0042              RETURN
0043              END
```

```
0001              SUBROUTINE DRWROADS
0002        ************************************************************
0003        *     THIS ROUTINE DRAWS THE HEX 'ROADS' FOR                *
0004        *     EACH OF A SPECIFIED SET OF HEXES.  IT                 *
0005        *     DRAWS FROM THE CENTER TO THE SIDES OF                 *
0006        *     EACH HEX.  IT IS LIMITED TO A LEVEL 8                 *
0007        *     HEX BY THE SIZES OF THE ARRAYS IN HXSTOR.CMN          *
0008        ************************************************************
0009              IMPLICIT INTEGER*4(H,P)
0010              INCLUDE 'UTIL:UNPACK.CMN'
0011     1  ************************************************************
0012     1        INTEGER*4 HSIDE(6) ! CONNECTIVITY CODES IN    *
0013     1                           ! NUMERICAL ORDER BY SIDE *
0014     1        COMMON/UNPACK/HSIDE
0015     1  ************************************************************
0016              INCLUDE 'HXSTOR.CMN'
0017     1  ************************************************************************
0018     1  *     THERE ARE 2401 LEVEL 4 HEXES IN A LEVEL 8 HEX                    *
0019     1        INTEGER*4 HXNO(2401) ! THE INTERNAL HEX NUMBERS                  *
0020     1        INTEGER*4 S(6)       ! S INDEXES THE HEX SIDES                   *
0021     1                             ! IN COUNTERCLOCKWISE ORDER                 *
0022     1        INTEGER*4 HXSIDES(2401) !PACKED HEX CONNECTIVITIES               *
0023     1        DIMENSION XY(2401,2) ! THE XY COORDINATES OF THE                 *
0024     1                             ! HEX CENTERS                               *
0025     1        COMMON /HXSTOR/HXN,HXNO,S,HXSIDES,XY
0026     1  ************************************************************************
0027              INCLUDE 'HXGRD.CMN'
0028     1  ************************************************
0029     1  *     PARAMETERS USED IN DRAWING THE HEXES AND  *
0030     1  *     THE LOC DATA                              *
0031     1  ************************************************
0032     1  *     PI 3.14159                                *
0033     1  *     X,Y THE RELATIVE POSITIONS OF THE HEX     *
0034     1  *         VERTICES                              *
0035     1  *     RAD  RADIUS IN METERS OF A HEX            *
0036     1  *     PHI  RELATIVE ROTATION TO THE START OF    *
0037     1  *          THE HEX DRAW;ie,THE 'BOTTOM'         *
0038     1  *     XPHI, THE RELATIVE DISTANCES TO THE START *
0039     1  *     YPHI   OF THE HEX DRAW                    *
0040     1  ************************************************
0041     1        REAL PI,PSI,PHI
0042     1        COMMON/HXGRD/X(6),Y(6),RAD,PHI,PI,
0043     1       +  XPHI,YPHI
0044     1  ************************************************
0045              DATA S/3,1,5,4,6,2/
0046        *     CONVERT BACK TO THE RADIUS OF THE INSCRIBED CIRCLE
0047              RRAD=RAD*SQRT(3.0)/2.0
0048                    TH=PHI-PI/6.0
0049        *     FOR EACH HEX                    *
0050              CALL CMOPEN
0051              DO I=1,HXN
0052                CALL UNPACKER(HXSIDES(I))
0053                CALL VECABS
0054        *       MOVE TO HEX CENTER            *
0055                CALL MOVE(XY(I,1),XY(I,2))
0056        *       FOR EACH SIDE                 *
0057                DO J=1,6
```

```
0058                    CALL VECREL
0059                    TH=TH+PI/3.0
0060                    IF(HSIDE(S(J)).NE.0)THEN
0061                      LTYP=HSIDE(S(J))
0062                      CALL LINCLR(LTYP)
0063                      CALL DRAW(RRAD*COS(TH),RRAD*SIN(TH))
0064                      CALL VECABS
0065     *                MOVE TO HEX CENTER      *
0066                      CALL MOVE(XY(I,1),XY(I,2))
0067                    ENDIF
0068     *              NEXT SIDE
0069                  ENDDO
0070     *            NEXT HEX
0071                ENDDO
0072                CALL VECABS
0073                CALL CMCLOS
0074                RETURN
0075                END
```

```
0001            SUBROUTINE FIXER
0002      ************************************************************
0003      *       THIS ROUTINE WILL ADD OR DELETE CONNECTIVITIES      *
0004      *       FROM THE 'HEXISED' LOC OR HYDRO DATA.               *
0005      ************************************************************
0006            IMPLICIT INTEGER H
0007            INCLUDE'UTIL:PACKER.CMN'
0008    1 ************************************************************
0009    1       INTEGER*4 SIDES ! PACKED CONNECTIVITIES              *
0010    1       INTEGER*4 LTYPE ! CONNECTIVITY FOR CURRENT SIDE      *
0011    1       COMMON/PACK/SIDES,LTYPE
0012    1 ************************************************************
0013            INCLUDE 'UTIL:UNPACK.CMN'
0014    1 ************************************************************
0015    1       INTEGER*4 HSIDE(6) ! CONNECTIVITY CODES IN           *
0016    1                          ! NUMERICAL ORDER BY SIDE         *
0017    1       COMMON/UNPACK/HSIDE
0018    1 ************************************************************
0019            INCLUDE 'TYPE.CMN'
0020    1 ************************************************************
0021    1       LOGICAL LOC   ! TYPE=ROADS                           *
0022    1       LOGICAL HYDRO ! TYPE=RIVERS                          *
0023    1       COMMON/TYPE/LOC,HYDRO
0024    1 ************************************************************
0025            DIMENSION HSTOR(2)
0026            CHARACTER ANS
0027            INTEGER*2 ICHAR
0028            DIMENSION XCENTR(2),YCENTR(2)
0029            DIMENSION ICHAR(2),PX(2),PY(2)
0030            DATA IMAXPT/2/
0031            INCLUDE 'GRAPH.CMN'
0032    1 ************************************************************
0033    1       REAL XMIN,XMAX,YMIN,YMAX ! WINDOW BOUNDARIES         *
0034    1                                ! IN METERS                 *
0035    1       INTEGER INT,LEV ! INTERVAL FOR ACCESSING THE         *
0036    1                       ! DATA AND LEVEL OF HEX              *
0037    1       COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT,LEV
0038    1 ************************************************************
0039            LEV=4
0040            ANS='Y'
0041            LTYPE=0
0042            LU=7
0043            CALL CMCLOS
0044            PRINT*,'ENTER 9 TO STOP.'
0045            DO WHILE(ANS.EQ.'Y')
0046                DO WHILE(LTYPE.NE.9)
0047                  CALL CMOPEN
0048                  CALL LOCATE(IMAXPT,PX,PY,ICHAR,IGOT)
0049                  DO I=1,2
0050                     X=PX(I)-500000.
0051                     Y=PY(I)-5700000.
0052                     CALL XYL2HA(X,Y,LEV,HSTOR(I))
0053                      CALL HA2XYL(HSTOR(I),XCENTR(I),YCENTR(I),LEV)
0054                      XCENTR(I)=XCENTR(I)+500000
0055                      YCENTR(I)=YCENTR(I)+5700000
0056                  ENDDO
0057                  LTYPE=ICHAR(2)-48
```

```
0058                    IF(LTYPE.GE.0.AND.LTYPE.LE.3)THEN
0059                      CALL REPACK(HSTOR,LTYPE)
0060                      IF(LOC)THEN
0061                        CALL MOVE(XCENTR(1),YCENTR(1))
0062                        IF(LTYPE.EQ.0)LTYPE=7
0063                        CALL LINCLR(LTYPE)
0064                        CALL DRAW(XCENTR(2),YCENTR(2))
0065                      ENDIF
0066                      IF(HYDRO)CALL DRW(XCENTR(2),YCENTR(2),HSIDE)
0067                    ENDIF
0068                  ENDDO
0069                CALL CMCLOS
0070                PRINT*,'MORE CHANGES?'
0071                READ(5,10)ANS
0072                IF(ANS.EQ.'Y')LTYPE=0
0073              ENDDO
0074    10        FORMAT(1A1)
0075              RETURN
0076              END
```

```
0001              SUBROUTINE GRIDINIT
0002      ****************************************
0003      *       THIS SETS THE X AND Y COORDINATE *
0004      *       LIMITS AND THE GRID INTERVAL.    *
0005      ****************************************
0006              INCLUDE 'DISPLAY.CMN'
0007    1 ************************************************************
0008    1 *       XO AND YO ARE THE CENTER COORDINATES OF THE DISPLAY *
0009    1 ************************************************************
0010    1         COMMON/DISPLAY/ XO,YO
0011    1 ************************************************************
0012              INCLUDE 'GRAPH.CMN'
0013    1 ********************************************************
0014    1         REAL XMIN,XMAX,YMIN,YMAX ! WINDOW BOUNDARIES *
0015    1                                  ! IN METERS         *
0016    1         INTEGER INT,LEV ! INTERVAL FOR ACCESSING THE *
0017    1                         ! DATA AND LEVEL OF HEX      *
0018    1         COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT,LEV
0019    1 ********************************************************
0020              DIMENSION LEVL(4)
0021              DATA LEVL/1,1,1,4/
0022              L=LEV-3
0023      *       SET THE X AND Y LIMITS.     *
0024              XMIN=XO-LEVL(L)*10000
0025              YMIN=YO-LEVL(L)*10000
0026              XMAX=XO+LEVL(L)*10000+1
0027              YMAX=YO+LEVL(L)*10000+1
0028              INT=10000
0029              CALL SETDEV
0030              CALL DRWGRD
0031              RETURN
0032              END
```

```
0001              SUBROUTINE HEXGEN(HXN,HXNO,LEVTOP,LEVBOT)
0002      ************************************************************
0003      *        THIS ROUTINE GENERATES HEX NUMBERS FROM           *
0004      *        'LEVTOP' TO 'LEVBOT',NESTED IN HEX FASHION.       *
0005      ************************************************************
0006      *        INPUTS: LEVTOP-- THE HIGHEST LEVEL OF HEX         *
0007      *                         TO BE GENERATED                  *
0008      *                LEVBOT-- THE LEVEL TO BE USED IN          *
0009      *                         FILLING THE HEX TREE             *
0010      *        OUTPUTS: HXN -- THE NUMBER OF HEXES GENERATED     *
0011      *                 HXNO -- THE ARRAY OF HEX NUMBERS         *
0012      ************************************************************
0013              IMPLICIT INTEGER (H,P)
0014              DIMENSION LEVSTOP(4:10)
0015              DIMENSION HXNO(2401)
0016              INTEGER*4 ZERO
0017      C...    THE VARIABLE 'LEVMIN' SHOULD BE (AND PROBABLY IS) SET ELSEWH
0018              LEVMIN=4
0019              ZERO=77777777
0020              L=LEVTOP-LEVBOT
0021              IF(L.EQ.0)THEN
0022                PRINT*,'ERROR IN HEXGEN'
0023                RETURN
0024              ENDIF
0025              HXN=7**(L-1)  !YOU MUST ASK FOR AT LEAST ONE LEVEL
0026              DO I=4,10
0027                 LEVSTOP(I)=0
0028              ENDDO
0029              DO I=LEVBOT,LEVTOP-1
0030                 LEVSTOP(I)=6
0031              ENDDO
0032              HXN=0
0033      C...    IF LEVSTOP(LEVEL)=0 THE LOOP IS ONLY EXECUTED ONCE, AND
0034      C...    THE DIGIT SUBTRACTED IS 0,..NO CHANGE
0035              DO LEV10=0,LEVSTOP(10)
0036                   L10=LEV10*1000000
0037                   DO LEV9=0,LEVSTOP(9)
0038                      L9=LEV9*100000
0039                      DO LEV8=0,LEVSTOP(8)
0040                         L8=LEV8*10000
0041                         DO LEV7=0,LEVSTOP(7)
0042                           L7=LEV7*1000
0043                           DO LEV6=0,LEVSTOP(6)
0044                              L6=LEV6*100
0045                              DO LEV5=0,LEVSTOP(5)
0046                                 L5=10*LEV5
0047                                 DO LEV4=0,LEVSTOP(4)
0048                                    L4=LEV4
0049                                    HXN=HXN+1
0050                                    HXNO(HXN)=ZERO-L10-L9-L8-L7-L6-L5-L4
0051 C  D                                  PRINT*,HXN,HXNO(HXN)
0052                                 ENDDO
0053                              ENDDO
0054                           ENDDO
0055                         ENDDO
0056                      ENDDO
0057                   ENDDO
```

```
0058                    ENDDO
0059 C  D          PRINT*,HXN,(HXNO(I),I=1,HXN)
0060               DO N=1,HXN
0061                  CALL HEXIN(HXNO(N),1,LEVMIN,HSTOR)
0062                  HXNO(N)=HSTOR
0063               ENDDO
0064               RETURN
0065               END
```

```
0001            SUBROUTINE HXGRDINIT(LEV)
0002      ************************************************************
0003      *       THIS INITIALIZES THE PARAMETERS FOR                *
0004      *       ACCESSING AND DRAWING THE HEX GRID                 *
0005      ************************************************************
0006      *       OUTPUTS: LEV-- THE LEVEL OF THE HEX TO BE DRAWN    *
0007      ************************************************************
0008            INCLUDE 'UTIL:HEX.CMN'
0009    1 ************************************************************************
0010    1 *       FOR DEFINITIONS OF VARIABLES SEE HXINIT.FOR
0011    1 ************************************************************************
0012    1       IMPLICIT INTEGER(H,P)
0013    1       COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMTR,
0014    1      +                XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0015    1      +                ICON(70),JCON(70),IMAX(7),JMAX(7)
0016    1 ************************************************************************
0017            INCLUDE 'DISPLAY.CMN'
0018    1 ************************************************************
0019    1 *       XO AND YO ARE THE CENTER COORDINATES OF THE DISPLAY *
0020    1 ************************************************************
0021    1       COMMON/DISPLAY/ XO,YO
0022    1 ************************************************************
0023            INCLUDE 'HXGRD.CMN'
0024    1 ******************************************************
0025    1 *       PARAMETERS USED IN DRAWING THE HEXES AND     *
0026    1 *       THE LOC DATA                                 *
0027    1 ******************************************************
0028    1 *       PI 3.14159                                   *
0029    1 *       X,Y THE RELATIVE POSITIONS OF THE HEX        *
0030    1 *           VERTICES                                 *
0031    1 *       RAD  RADIUS IN METERS OF A HEX               *
0032    1 *       PHI  RELATIVE ROTATION TO THE START OF       *
0033    1 *            THE HEX DRAW;ie,THE 'BOTTOM'            *
0034    1 *       XPHI, THE RELATIVE DISTANCES TO THE START    *
0035    1 *       YPHI   OF THE HEX DRAW                       *
0036    1 ******************************************************
0037    1       REAL PI,PSI,PHI
0038    1       COMMON/HXGRD/X(6),Y(6),RAD,PHI,PI,
0039    1      +  XPHI,YPHI
0040    1 ******************************************************
0041            DATA PI/3.14159/
0042            PRINT*,'WHAT LEVEL OF HEX DO YOU WANT?'
0043            READ*,LEV
0044            PRINT*,'ENTER THE X,Y COORDINATES OF THE CENTER'
0045            PRINT*,'AS AN OFFSET IN METERS FROM NC00:'
0046            READ*,XO,YO
0047      *     IT SEEMS EASIER TO HAVE THE OPERATOR PUT THE
0048      *     COORDINATES RELATIVE TO NC00, BUT ALL THE HEX
0049      *     UTILITIES ARE OFFSETS FROM THE CENTER HEX.
0050            XO=500000+XO
0051            YO=5700000+YO
0052            INCLUDE 'UTIL:HEXINIT.PRM'
0053    1 ************************************************************
0054    1 *       IWRITE:  OUTPUT DEVICE FOR ERROR MESSAGES          *
0055    1 *       LEVMAX:  MAXIMUM LEVEL OF HEX AGGREGATION          *
0056    1 *       LEVMIN:  MINIMUM   "        "   "                  *
0057    1 *       DLT:  LATITUDE OF THE ORIGIN HEX IN FLOATING-      *
```

```
0058   1 *        POINT DEGREES                                                *
0059   1 *        DLN:  LONGITUDE OF ORIGIN HEX                                *
0060   1 *        LEVS Z:  HEX LEVEL AT WHICH THE SCALE OF THE                 *
0061   1 *        HEX COORDINATE SYSTEM IS GIVEN                               *
0062   1 *        SIZHEX:  DIAMETER OF HEXES AT SIZE 'LEVSIZ' IN               *
0063   1 *        FLOATING-POINT METERS                                        *
0064   1          IWRITE=6
0065   1          LEVMAX=9
0066   1          LEVMIN=4
0067   1          DLT=51.45
0068   1          DLN=9.00
0069   1          LEVSIZ=6
0070   1          SIZHEX=25000.
0071   1          CALL HXINIT(IWRITE,LEVMAX,LEVMIN,DLT,DLN,LEVSIZ,SIZHEX)
0072   1 ************************************************************************
0073               RAD=DIAMTR/2.0
0074     *         'DIAMTR' IS THE DIAMETER OF THE INSCRIBED CIRCLE
0075               RAD=2*RAD/SQRT(3.0)
0076     *         PHI IS THE ROTATION OF THE HEX GRID FROM NORTH
0077               PHI=(LEVMIN*19.1)*PI/180
0078               XPHI=RAD*COS(PHI)
0079               YPHI=RAD*SIN(PHI)
0080               PSI=PHI+PI/3
0081     *         SET THE RELATIVE POSITIONS OF THE VERTICES
0082               DO I=1,6
0083                  PSI=PSI+PI/3
0084                  X(I)=COS(PSI)*RAD
0085                  Y(I)=SIN(PSI)*RAD
0086               ENDDO
0087               RETURN
0088               END
```

```
0001              SUBROUTINE MARKER
0002      ************************************************
0003      *       THIS ROUTINE JUST WRITES THE RELATIVE   *
0004      *       COORDINATES OF THE LOWER LEFT CORNER    *
0005      ************************************************
0006              INCLUDE 'GRAPH.CMN'
0007    1 ********************************************************
0008    1         REAL XMIN,XMAX,YMIN,YMAX ! WINDOW BOUNDARIES *
0009    1                                  ! IN METERS         *
0010    1         INTEGER INT,LEV ! INTERVAL FOR ACCESSING THE *
0011    1                         ! DATA AND LEVEL OF HEX      *
0012    1         COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT,LEV
0013    1 ********************************************************
0014              CALL CMOPEN
0015              CALL TXTCLR(0)
0016              ISIZE=0
0017              PX=2
0018              PY=3
0019              CALL TXAM
0020              CALL TXSIZE(ISIZE,PX,PY)
0021      *       IMAXX AND IMAXY ARE THE NUMBER OF DIGITS IN  *
0022      *       THE X AND Y COORDINATES, RESPECTIVELY.       *
0023      *       SET X AND Y TO THE UTM COORDINATES OF THE    *
0024      *       SW CORNER
0025              XX=ALOG10(XMIN)
0026              IMAXX=NINT(XX)+1
0027              YY=ALOG10(YMIN)
0028              IMAXY=NINT(YY)+1
0029      *       PROPORTION THE MOVE RELATIVE TO THE WINDOW SIZE *
0030      *       THE 400 WAS ARRIVED AT HEURISTICALLY            *
0031              N=(YMAX-YMIN)/10000+1
0032              CALL MOVE(XMIN,YMIN+400*N)
0033              CALL RNUMBR(XMIN,-1,IMAXX)
0034              CALL MOVE(XMIN,YMIN)
0035              CALL RNUMBR(YMIN,-1,IMAXY)
0036              CALL CMCLOS
0037              RETURN
0038              END
```

```
0001           SUBROUTINE SETDEV
0002      ********************************
0003      *        SETS GRAPHICS ENVIRONMENT *
0004      ********************************
0005           INCLUDE 'GRAPH.CMN'
0006    1 ************************************************
0007    1      REAL XMIN,XMAX,YMIN,YMAX ! WINDOW BOUNDARIES *
0008    1                               ! IN METERS         *
0009    1      INTEGER INT,LEV ! INTERVAL FOR ACCESSING THE *
0010    1                      ! DATA AND LEVEL OF HEX      *
0011    1      COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT,LEV
0012    1 ************************************************
0013      ************************************************
0014      *        INITIALIZING AND DEFINING THE COLORS USED *
0015      *        IN DRAWING THE HEX CONNECTIVITIES AND LOC *
0016      ************************************************
0017           DIMENSION RED1(3),RED2(3),BLUE1(3),BLUE2(3)
0018           DIMENSION GREEN1(3),GREEN2(3),BKGRND(3),BLACK(3)
0019           DATA RED1/30.,10.,10./,RED2/30.,10.,10./
0020           DATA BLUE1/10.,20.,100./,BLUE2/10.,20.,100./
0021           DATA GREEN1/20.,60.,5./,GREEN2/20.,60.,5./
0022           DATA BKGRND/30.,30.,30./,BLACK/0.,0.,0./
0023      ************************************************************
0024           IDEVICE=4027
0025           IOPT=5
0026           CALL GRSTRT(IDEVICE, IOPT)
0027           CALL CMOPEN
0028           XMN=XMIN-5000
0029           XMX=XMAX+5000
0030           YMN=YMIN-5000
0031           YMX=YMAX+5000
0032           CALL WINDOW(XMN,XMX,YMN,YMX)
0033      ************************************************************
0034      *        THE '1' COLORS ARE USED IN DRAWING THE HEXLOC      *
0035      *        DATA AND THE '2' COLORS FOR THE ORIGINAL LOC DATA  *
0036      ************************************************************
0037           CALL CLRMAP(1,1,GREEN1)
0038           CALL CLRMAP(2,1,BLUE1)
0039           CALL CLRMAP(3,1,RED1)
0040           CALL CLRMAP(4,1,RED2)
0041           CALL CLRMAP(5,1,BLUE2)
0042           CALL CLRMAP(6,1,GREEN2)
0043           CALL CLRMAP(7,1,BKGRND)
0044           CALL CLRMAP(0,1,BLACK)
0045           CALL BKGCLR(7)
0046      *
0047           CALL VWPORT(30.,129.3,0.,99.3)
0048           CALL CMCLOS
0049         RETURN
0050         END
```

```
0001            SUBROUTINE SETHXGRD(MINLEV)
0002      ***********************************************
0003      *       SETS THE XY ADDRESSES OF THE HEXES      *
0004      *       AND READS THE CONNECTIVITIES IN.        *
0005      ***********************************************
0006      *       INPUTS: MINLEV-- THE MINIMUM HEX LEVEL  *
0007      ***********************************************
0008            IMPLICIT INTEGER(H,P)
0009            INCLUDE 'HXSTOR.CMN'
0010    1 ****************************************************************
0011    1 *       THERE ARE 2401 LEVEL 4 HEXES IN A LEVEL 8 HEX          *
0012    1       INTEGER*4 HXNO(2401) ! THE INTERNAL HEX NUMBERS        *
0013    1       INTEGER*4 S(6)       ! S INDEXES THE HEX SIDES         *
0014    1                            ! IN COUNTERCLOCKWISE ORDER       *
0015    1       INTEGER*4 HXSIDES(2401) !PACKED HEX CONNECTIVITIES     *
0016    1       DIMENSION XY(2401,2) ! THE XY COORDINATES OF THE       *
0017    1                            ! HEX CENTERS                     *
0018    1       COMMON /HXSTOR/HXN,HXNO,S,HXSIDES,XY
0019    1 ****************************************************************
0020            INCLUDE 'DISPLAY.CMN'
0021    1 ********************************* ***************************
0022    1 *       XO AND YO ARE THE CENTER COORDINATES OF THE DISPLAY *
0023    1 ****************************************************************
0024    1       COMMON/DISPLAY/ XO,YO
0025    1 ****************************************************************
0026            INCLUDE 'UTIL:HEXROAD.OPN'
0027    1 *       THIS OPENS THE ISAM FILE USED TO PROCESS AND    *
0028    1 *       DISPLAY THE LOC AND HYDRO DATA .                *
0029    1       OPEN(UNIT=7,NAME='HEXROAD',STATUS='UNKNOWN',
0030    1      +  ORGANIZATION='INDEXED',ACCESS='KEYED',RECL=2,
0031    1      +  RECORDTYPE='FIXED',FORM='UNFORMATTED',
0032    1      +  KEY=(1:4:INTEGER),SHARED)
0033    1 *
0034            LU=7
0035            XO=XO-500000
0036            YO=YO-5700000
0037            CALL XYL2HA(XO,YO,MINLEV,HEXO) ! SET CENTER HEX
0038            DO I=1,HXN ! FOR EACH HEX
0039               HXNO(I)=HXADD(HXNO(I),HEXO) ! TRANSLATE
0040               CALL HEXREAD(HXNO(I),HXSIDES(I),LU) ! GET SIDES
0041               CALL HA2XYL(HXNO(I),X,Y,MINLEV) ! GET XY COORDINATES
0042               XY(I,1)=X+500000    ! BOTH COORDINATE SYSTEMS ARE
0043               XY(I,2)=Y+5700000   ! CENTERED AT 32UNC00
0044            ENDDO
0045            RETURN
0046            END
```

```
0001              SUBROUTINE DRAWROADS(XMIN,XMAX,YMIN,YMAX)
0002      ************************************************************
0003      *       THIS SET OF ROUTINES SUPERIMPOSES THE BDM-          *
0004      *       DERIVED ROADNET ON THE HEX CONNECTIVITIES FOR       *
0005      *       COMPARISON.                                         *
0006      ************************************************************
0007      *       INPUTS:XMIN,ETC--BOUNDING COORDINATES IN METERS     *
0008      ************************************************************
0009              INTEGER*4 I,J,X,Y
0010              INCLUDE 'UTIL:LNKNOD.CMN'
0011    1 ********************************************************************
0012    1 *       ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES            *
0013    1 ********************************************************************
0014    1         INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0015    1         COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0016    1        +  ,SUBREC(500)
0017    1 ********************************************************************
0018              INCLUDE 'UTIL:LNKNOD.OPN'
0019    1 *       OPENING THE GRID,NODE,LINK,AND SUBNODE FILES
0020    1           OPEN(UNIT=1,NAME='GRID',TYPE='OLD',READONLY,
0021    1        *ACCESS='DIRECT',BLOCKSIZE=2000,SHARED)
0022    1           OPEN(UNIT=2,NAME='NODE',TYPE='OLD',READONLY,
0023    1        *ACCESS='DIRECT',BLOCKSIZE=2000,SHARED)
0024    1           OPEN(UNIT=3,NAME='ROAD',TYPE='OLD',READONLY,
0025    1        *ACCESS='DIRECT',BLOCKSIZE=2000,SHARED)
0026    1           OPEN(UNIT=4,NAME='SUBN',TYPE='OLD',READONLY,
0027    1        *ACCESS='DIRECT',BLOCKSIZE=2000,SHARED)
0028    1 *
0029      *
0030      *       READ IN GRID FILE
0031              CALL GRIDR
0032      *       FOR EACH GRID
0033      *
0034              DO X=XMIN-10000,XMAX,10000
0035      *          DISTANCES ARE MEASURED IN UNITS OF 20 METERS FROM
0036      *          AN ORIGIN OF 500000M N, 5600000M E.  THE ORIGIN
0037      *          CORRESPONDS TO  GRID INDICES OF (65,65).
0038                 DO Y=YMIN-10000,YMAX,10000
0039                      CALL IGRID(X,Y,I,J)
0040                      CALL DRWREC(GRID(I,J))
0041                 ENDDO
0042              ENDDO
0043              RETURN
0044              END
```

```
0001            SUBROUTINE DRW(XX,YY,SIDES)
0002      ************************************************************
0003      *          INPUTS:                                         *
0004      *                 XX,YY--CENTER OF THE HEX TO BE DRAWN     *
0005      *                 SIDES-- THE COLOR CODES FOR THE HEX      *
0006      ************************************************************
0007            IMPLICIT INTEGER (H,P)
0008            INTEGER SIDES(6)
0009            INCLUDE 'HXGRD.CMN'
0010    1 ******************************************************
0011    1 *       PARAMETERS USED IN DRAWING THE HEXES AND     *
0012    1 *       THE LOC DATA                                 *
0013    1 ******************************************************
0014    1 *       PI 3.14159                                   *
0015    1 *       X,Y THE RELATIVE POSITIONS OF THE HEX        *
0016    1 *           VERTICES                                 *
0017    1 *       RAD  RADIUS IN METERS OF A HEX               *
0018    1 *       PHI  RELATIVE ROTATION TO THE START OF       *
0019    1 *            THE HEX DRAW;ie,THE 'BOTTOM'            *
0020    1 *       XPHI, THE RELATIVE DISTANCES TO THE START    *
0021    1 *       YPHI   OF THE HEX DRAW                       *
0022    1 ******************************************************
0023    1       REAL PI,PSI,PHI
0024    1       COMMON/HXGRD/X(6),Y(6),RAD,PHI,PI,
0025    1      +  XPHI,YPHI
0026    1 ******************************************************
0027      *     THIS IS THE ORDER IN WHICH THE SIDES ARE DRAWN
0028            INTEGER S(6)
0029            DATA S/3,1,5,4,6,2/
0030            CALL VECABS
0031            CALL MOVE(XX,YY)
0032            CALL VECREL
0033            CALL MOVE(XPHI,YPHI)
0034            DO J=1,6
0035               LTYP=SIDES(S(J))
0036               CALL LINCLR(LTYP)
0037               CALL DRAW(X(J),Y(J))
0038            ENDDO
0039            RETURN
0040            END
```

```
0001              SUBROUTINE DRWGRD
0002     ************************************************************
0003     *        THIS ROUTINE DRAWS THE GRID LINES                 *
0004     ************************************************************
0005              INCLUDE 'GRAPH.CMN'
0006    1 ********************************************************
0007    1         REAL XMIN,XMAX,YMIN,YMAX ! WINDOW BOUNDARIES    *
0008    1                                  ! IN METERS            *
0009    1         INTEGER INT,LEV ! INTERVAL FOR ACCESSING THE    *
0010    1                         ! DATA AND LEVEL OF HEX         *
0011    1         COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT,LEV
0012    1 ********************************************************
0013              CALL CMOPEN
0014              CALL BKGCLR(7)
0015              CALL NEWPAG
0016              CALL LINCLR(0)
0017     *        DRAW THE HORIZONTAL GRID LINES
0018              YINT=INT
0019              DO Y=YMIN,YMAX,YINT
0020                      CALL MOVE(XMIN,Y)
0021                      CALL DRAW(XMAX,Y)
0022              ENDDO
0023     *        DRAW THE VERTICAL GRID LINES
0024              XINT=INT
0025              DO X=XMIN,XMAX,XINT
0026                      CALL MOVE(X,YMIN)
0027                      CALL DRAW(X,YMAX)
0028              ENDDO
0029     *        PRINT THE LOWER LEFT COORDINATES
0030              CALL CMCLOS
0031              CALL MARKER
0032              RETURN
0033              END
```

```
0001            PROGRAM DRWHEX
0002      ****************************************
0003      *       A SET OF  ROUTINES TO DISPLAY THE *
0004      *       LOC AND 'HEXISED LOC DATA AND     *
0005      *       THE ASSOCIATED GRIDS.             *
0006      ****************************************
0007            INCLUDE 'UTIL:HEX.CMN'
0008    1 ************************************************************************
0009    1 *       FOR DEFINITIONS OF VARIABLES SEE HXINIT.FOR
0010    1 ************************************************************************
0011    1       IMPLICIT INTEGER(H,P)
0012    1       COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMIR
0013    1      +               XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0014    1      +               ICON(70),JCON(70),IMAX(7),JMAX(7)
0015    1 ************************************************************************
0016            INCLUDE 'HXSTOR.CMN'
0017    1 ************************************************************
0018    1 *       THERE ARE 2401 LEVEL 4 HEXES IN A LEVEL 8 HEX      *
0019    1         INTEGER*4 HXNO(2401) ! THE INTERNAL HEX NUMBERS    *
0020    1         INTEGER*4 S(6)       ! S INDEXES THE HEX SIDES     *
0021    1                              ! IN COUNTERCLOCKWISE ORDER   *
0022    1         INTEGER*4 HXSIDES(2401) !PACKED HEX CONNECTIVITIES *
0023    1         DIMENSION XY(2401,2) ! THE XY COORDINATES OF THE   *
0024    1                              ! HEX CENTERS                 *
0025    1         COMMON /HXSTOR/HXN,HXNO,S,HXSIDES,XY
0026    1 ************************************************************
0027            INCLUDE 'GRAPH.CMN'
0028    1 ********************************************************
0029    1         REAL XMIN,XMAX,YMIN,YMAX ! WINDOW BOUNDARIES *
0030    1                                  ! IN METERS         *
0031    1         INTEGER INT,LEV ! INTERVAL FOR ACCESSING THE *
0032    1                         ! DATA AND LEVEL OF HEX      *
0033    1         COMMON /GRAPH/XMIN,XMAX,YMIN,YMAX,INT,LEV
0034    1 ********************************************************
0035            INCLUDE 'TYPE.CMN'
0036    1 ****************************************************
0037    1         LOGICAL LOC   ! TYPE=ROADS                 *
0038    1         LOGICAL HYDRO ! TYPE=RIVERS                *
0039    1         COMMON/TYPE/LOC,HYDRO
0040    1 ****************************************************
0041            CHARACTER*1 IANS
0042            PRINT*,'LOC OR HYDRO?'
0043            READ(5,10)IANS
0044            IF(IANS.EQ.'L')LOC=.TRUE.
0045            IF(IANS.EQ.'H')HYDRO=.TRUE.
0046            IF(.NOT.LOC.AND..NOT.HYDRO)THEN
0047              PRINT*,'INVALID TYPE; TRY AGAIN'
0048              STOP
0049            ENDIF
0050            IANS='Y'
0051            DO WHILE(IANS.EQ.'Y')
0052              CALL HXGRDINIT(LEV)
0053              CALL GRIDINIT
0054              CALL HEXGEN(HXN,HXNO,LEV,MINLEV)
0055              CALL SETHXGRD(MINLEV)
0056              CALL DRWHXGRD
0057              IF(LOC)CALL DRWROADS
```

```
0058                PRINT*,'ROADS?'
0059                READ(5,10)IANS
0060     10         FORMAT(1A1)
0061                IF(IANS.EQ.'Y')THEN
0062                   CALL DRAWROADS(XMIN,XMAX,YMIN,YMAX)
0063                ENDIF
0064                CALL FIXER
0065                PRINT*,'ANOTHER RUN?'
0066                READ(5,10)IANS
0067             ENDDO
0068             CALL GRSTOP
0069             END
```

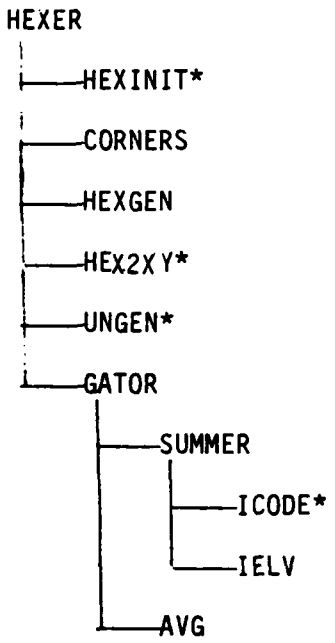
```
0001              SUBROUTINE DRWHXGRD
0002      ************************************************
0003      *       CALLS 'DRW' TO DRAW A HEX EITHER IN    *
0004      *       BLACK AND WHITE OR HAVING COLOR, AS    *
0005      *       NEEDS BE.                              *
0006      ************************************************
0007              IMPLICIT INTEGER(H,P)
0008              INCLUDE 'HXGRD.CMN'
0009    1 ******************************************************
0010    1 *       PARAMETERS USED IN DRAWING THE HEXES AND     *
0011    1 *       THE LOC DATA                                 *
0012    1 ******************************************************
0013    1 *       PI 3.14159                                   *
0014    1 *       X,Y THE RELATIVE POSITIONS OF THE HEX        *
0015    1 *           VERTICES                                 *
0016    1 *       RAD  RADIUS IN METERS OF A HEX               *
0017    1 *       PHI  RELATIVE ROTATION TO THE START OF       *
0018    1 *            THE HEX DRAW;ie,THE 'BOTTOM'            *
0019    1 *       XPHI, THE RELATIVE DISTANCES TO THE START    *
0020    1 *       YPHI   OF THE HEX DRAW                       *
0021    1 ******************************************************
0022    1         REAL PI,PSI,PHI
0023    1         COMMON/HXGRD/X(6),Y(6),RAD,PHI,PI,
0024    1        +  XPHI,YPHI
0025    1 ******************************************************
0026              INCLUDE 'UTIL:UNPACK.CMN'
0027    1 ******************************************************
0028    1         INTEGER*4 HSIDE(6) ! CONNECTIVITY CODES IN   *
0029    1                            ! NUMERICAL ORDER BY SIDE *
0030    1         COMMON/UNPACK/HSIDE
0031    1 ******************************************************
0032              INCLUDE 'HXSTOR.CMN'
0033    1 ************************************************************
0034    1 *       THERE ARE 2401 LEVEL 4 HEXES IN A LEVEL 8 HEX      *
0035    1         INTEGER*4 HXNO(2401) ! THE INTERNAL HEX NUMBERS    *
0036    1         INTEGER*4 S(6)       ! S INDEXES THE HEX SIDES     *
0037    1                              ! IN COUNTERCLOCKWISE ORDER   *
0038    1         INTEGER*4 HXSIDES(2401) !PACKED HEX CONNECTIVITIES *
0039    1         DIMENSION XY(2401,2) ! THE XY COORDINATES OF THE   *
0040    1                              ! HEX CENTERS                 *
0041    1         COMMON /HXSTOR/HXN,HXNO,S,HXSIDES,XY
0042    1 ************************************************************
0043              INCLUDE 'TYPE.CMN'
0044    1 ************************************************
0045    1         LOGICAL LOC   ! TYPE=ROADS              *
0046    1         LOGICAL HYDRO ! TYPE=RIVERS             *
0047    1         COMMON/TYPE/LOC,HYDRO
0048    1 ************************************************
0049              CALL CMOPEN
0050              IF (LOC)THEN
0051                DO J=1,6
0052                  HSIDE(J)=0
0053                ENDDO
0054              ENDIF
0055              DO I=1,HXN
0056                IF(HYDRO) CALL UNPACKER(HXSIDES(I))
0057                CALL DRW(XY(I,1),XY(I,2),HSIDE)
```

```
0058                ENDDO
0059                CALL VECABS
0060                CALL CMCLOS
0061                RETURN
0062                END
```

```
0001              SUBROUTINE DRWLNK2(X,Y,NXTLNK)
0002      ************************************************************
0003      *       THIS ROUTINE DRAWS THE 'OUTLINK'                   *
0004      *       ORIGINATING AT NODE X,Y AND GETS THE POINTER       *
0005      *       TO THE NEXT LINK AT THIS NODE                      *
0006      ************************************************************
0007      *       INPUTS:                                            *
0008      *              X,Y-- COORDINATES OF THE START NODE         *
0009      *              NXTLNK-- THE FIRST OUTLINK AT THE NODE      *
0010      *       OUTPUTS: NXTLNK                                    *
0011      ************************************************************
0012              INTEGER*4 TMPLINK,SRECNUM,WRDPOS,NOD
0013              INTEGER*2 ICLR,X,Y
0014              INTEGER*2 NUM
0015              INCLUDE 'UTIL:SUB.CMN'
0016    1 ************************************************************
0017    1 *****   SUBX,SUBY THE X AND Y COORDINATES OF THE SUBNODES
0018    1 *****             IN ONE LINK (SEE BDM DOCUMENTATION)
0019    1 ************************************************************
0020    1         INTEGER*2 SUBX(100),SUBY(100)
0021    1         COMMON/SUB/ SUBX,SUBY
0022    1 ************************************************************
0023              INCLUDE 'UTIL:LNKNOD.CMN'
0024    1 ************************************************************
0025    1 *       ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES      *
0026    1 ************************************************************
0027    1         INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0028    1         COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0029    1        +,SUBREC(500)
0030    1 ************************************************************
0031              INCLUDE 'TYPE.CMN'
0032    1 ************************************************************
0033    1         LOGICAL LOC   ! TYPE=ROADS                         *
0034    1         LOGICAL HYDRO ! TYPE=RIVERS                        *
0035    1         COMMON/TYPE/LOC,HYDRO
0036    1 ************************************************************
0037              CALL CMOPEN
0038              CALL GETNDX(NXTLNK,LRECNUM,WRDPOS)
0039              N=WRDPOS
0040              LU=3
0041              CALL GETREC(LU,LRECNUM,LNKREC)
0042      *       SET LINK TYPE                                *
0043              TMPLINK=LIB$EXTZV(0,16,LNKREC(3,N))
0044              CALL LIB$INSV(TMPLINK,0,16,LTYPE)
0045      *
0046              IF(HYDRO)LTYPE=LTYPE-11
0047      *       NOT ALL TYPES OF LINKS ARE DRAWN   *
0048              IF(LTYPE.LE.3)THEN
0049                 IF (LTYPE.LT.0)LTYPE=-3
0050                 ICLR=LTYPE+3
0051                 CALL LINCLR(ICLR)
0052      *
0053      *       SET SUBNODE PHYSICAL RECORD NUMBER  *
0054              TMPLINK=LIB$EXTZV(0,16,LNKREC(5,N))
0055              CALL LIB$INSV(TMPLINK,0,16,SRECNUM)
0056      *       SET SUBNODE WORD NUMBER             *
0057              TMPLINK=LIB$EXTZV(16,16,LNKREC(5,N))
```

```
0058                CALL LIBSINSV(TMPLINK,0,16,WRDPOS)
0059      *
0060      *
0061      *         IF THERE ARE NO SUBNODES SET NXTLNK AND RETURN *
0062                   IF(SRECNUM.GT.0.AND.WRDPOS.GT.0)THEN
0063                      CALL GETSUB(SRECNUM,WRDPOS,NUM)
0064                      CALL MOVE(TRANX(X),TRANY(Y))
0065      *
0066                      DO I=1,NUM
0067      *               DRAW TO EACH SUBNODE                          *
0068                         CALL DRAW(TRANX(SUBX(I)),TRANY(SUBY(I)))
0069                      ENDDO
0070                      NOD=LNKREC(4,N)
0071                      CALL DRWNOD(NOD)
0072      10              CONTINUE
0073                   ENDIF
0074                ENDIF
0075                NXTLNK=LNKREC(2,N)
0076                CALL CMCLOS
0077                RETURN
0078                END
```

HEXER CALLING SEQUENCE



*TERRAIN SYSTEM UTILITIES

Figure B-7.

PROGRAM: HEXER

ROUTINE \ COMMON	CENTER	CODE	CORNER	HEX	HEXRAD	MAXMIN	MAP
AVG		X					
CORNERS						X	
GATOR		X	X		X		
HEX2XY	X						
HEXER			X			X	
HEXINIT				X	X		
ICODE							X
IELV							X
MAPIN							X
SUMMER		X			X		

Figure B-8.

```
0001              SUBROUTINE AVG(HXNO,X,Y)
0002        ************************************************************
0003        *     THIS ROUTINE AVERAGES THE ELEVATIONS,SLOPES,AND CODES *
0004        *     FOR ONE HEX AND WRITES THE RESULTS.                   *
0005        ************************************************************
0006        *     INPUTS: HXNO-- EXTERNAL FORM OF THE HEX NUMBER        *
0007        *               X,Y--  UTM COORDINATES OF THE HEX CENTER    *
0008        ************************************************************
0009              IMPLICIT INTEGER*2 (H-P)
0010              INTEGER*4 HXNO
0011              INCLUDE 'CODE.CMN'
0012      1 ************************************************************
0013      1 *     ICOD CONTAINS THE COUNTS OF THE RESPECTIVE SURFACE CODES *
0014      1 *     COD CONTAINS THE RESPECTIVE PERCENTAGES               *
0015      1 *     SSUM IS THE SUM OF THE ABSOLUTE SLOPES                *
0016      1 *     ZSUM IS THE SUM OF THE ELEVATIONS                     *
0017      1 *     NSLOPES IS THE NUMBER OF SLOPES COUNTED               *
0018      1 *     AND NPOINTS IS THE NUMBER OF POINTS COUNTED           *
0019      1 ************************************************************
0020      1         INTEGER*2 ICOD(0:2)
0021      1         DIMENSION COD(0:2)
0022      1         COMMON/CODE/ICOD,COD,SSUM,ZSUM,NSLOPES,NPOINTS
0023      1 ************************************************************
0024                S=NSLOPES
0025                S=S*100.  ! DATA BASE RESOLUTION OF 100M
0026                SLOPE=SSUM/S
0027                ELEV=ZSUM/NPOINTS
0028        *
0029        *     FOR EACH FEATURE CODE
0030                DO I=0,2
0031        *          COMPUTE % FEATURE TYPE
0032                   COD(I)=ICOD(I)
0033                   COD(I)=COD(I)/NPOINTS
0034        *          NEXT TYPE
0035                ENDDO
0036              LU=3
0037              WRITE(LU,11)HXNO,X,Y,SLOPE,ELEV,(COD(I),I=0,2),NPOINTS
0038             +  ,NSLOPES
0039        11    FORMAT(1X,I8,2F10.0,5F8.2,2I5)
0040              RETURN
0041              END
```

```
0001            FUNCTION BETWEEN(X,X1,X2)
0002      ************************************************************
0003      *       A ROUTINE WHICH JUST DETERMINES                    *
0004      *       WHETHER OR NOT X IS BETWEEN X1 AND X2.             *
0005      ************************************************************
0006      *       INPUTS: X,X1,X2--UTM COORDINATE VALUES             *
0007      *       OUTPUTS: BETWEEN-- A LOGICAL TRUE OR FALSE         *
0008      *       N.B.  ***SINCE X IS REAL AND X1 AND X2 ARE         *
0009      *             ***INTEGER, CLOSE CALLS MAY BE UNRELIABLE    *
0010      ************************************************************
0011            INTEGER X1,X2
0012            LOGICAL BETWEEN
0013            IF((X1-X).GT.0.OR.(X-X2).GT.0)THEN
0014              BETWEEN=.FALSE.
0015            ELSE
0016              BETWEEN=.TRUE.
0017            ENDIF
0018            RETURN
0019            END
```

```
0001            FUNCTION BETWEEN(X,X1,X2)
0002      ************************************************************
0003      *       A ROUTINE WHICH JUST DETERMINES                    *
0004      *       WHETHER OR NOT X IS BETWEEN X1 AND X2.             *
0005      ************************************************************
0006      *       INPUTS: X,X1,X2--UTM COORDINATE VALUES             *
0007      *       OUTPUTS: BETWEEN-- A LOGICAL TRUE OR FALSE         *
0008      *       N.B.  ***SINCE X IS REAL AND X1 AND X2 ARE         *
0009      *             ***INTEGER, CLOSE CALLS MAY BE UNRELIABLE    *
0010      ************************************************************
0011            INTEGER X1,X2
0012            LOGICAL BETWEEN
0013            IF((X1-X).GT.0.OR.(X-X2).GT.0)THEN
0014              BETWEEN=.FALSE.
0015            ELSE
0016              BETWEEN=.TRUE.
0017            ENDIF
0018            RETURN
0019            END
```

```
0001              SUBROUTINE CORNERS
0002      ********.****.**********************************************
0003      *       THIS ROUTINE SETS THE COORDINATES OF THE CORNERS OF  *
0004      *       THE TERRAIN BOX BEING PROCESSED.                     *
0005      ************************************************************
0006              INCLUDE 'MAXMIN.CMN'
0007    1 ************************************************************
0008    1 *       THE UTM LIMITS OF THE RECTANGLE OF INTEREST         *
0009    1 ************************************************************
0010    1         INTEGER XMIN,XMAX,YMIN,YMAX
0011    1         COMMON /MAXMIN/XMIN,XMAX,YMIN,YMAX
0012    1 ************************************************************
0013              PRINT*,'ENTER THE SOUTHWEST COORDINATES IN METERS:'
0014              PRINT*,'EASTING:'
0015              READ(5,*)XMIN
0016              PRINT*,'NORTHING:'
0017              READ(5,*)YMIN
0018              PRINT*,'NOW ENTER THE NORTHWEST COORDINATES:'
0019              PRINT*,'EASTING:'
0020              READ(5,*)XMAX
0021              PRINT*,'NORTHING:'
0022              READ(5,*)YMAX
0023      C...    NOW EXPAND THE BOUNDARY SO THAT HEXES WHICH INTERSECT,
0024      C...    BUT ARE NOT CENTERED IN THE AREA OF INTEREST WILL BE
0025      C...    PROCESSED.
0026              XMIN=XMIN-12500  !ROUGHLY THE RADIUS OF A LEVEL 6 HEX
0027              XMAX=XMAX+12500
0028              YMIN=YMIN-12500
0029              YMAX=YMAX+12500
0030              RETURN
0031              END
```

```
0001            SUBROUTINE GATOR(X,Y,HXNO)
0002      ************************************************************
0003      *       (THIS IS THE AGGRE'GATOR')                         *
0004      *       THIS ROUTINE IS DESIGNED TO AGGREGATE              *
0005      *       HEX DATA FROM A VERSION OF THE                     *
0006      *       TERRAIN DISPLAY FILE.                              *
0007      ************************************************************
0008      *       INPUTS: X,Y-- COORDINATES OF THE CENTER OF THE     *
0009      *                     HEX ( IN METERS FROM HEX ORIGIN)     *
0010      *               HXNO-- EXTERNAL HEX NUMBER                 *
0011      ************************************************************
0012            IMPLICIT INTEGER*2 (H-P)
0013            INTEGER*4 HXNO,INTX,INTY,IX,IY
0014            INCLUDE 'CORNER.CMN'
0015    1 ************************************************************
0016    1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE   *
0017    1 *       AREA REPRESENTED BY THE DATA IN IBUF.              *
0018    1 ************************************************************
0019    1       INTEGER*4 SWX,SWY
0020    1       COMMON/CORNER/SWX,SWY
0021    1 ************************************************************
0022            INCLUDE 'HEXRAD.CMN'
0023    1       INTEGER*2 DBRES,HEXR
0024    1       COMMON/HEXRAD/DBRES,RAD2,HEXR
0025            INCLUDE 'CODE.CMN'
0026    1 ************************************************************************
0027    1 *       ICOD CONTAINS THE COUNTS OF THE RESPECTIVE SURFACE CODES       *
0028    1 *       COD CONTAINS THE RESPECTIVE PERCENTAGES                        *
0029    1 *       SSUM IS THE SUM OF THE ABSOLUTE SLOPES                         *
0030    1 *       ZSUM IS THE SUM OF THE ELEVATIONS                              *
0031    1 *       NSLOPES IS THE NUMBER OF SLOPES COUNTED                        *
0032    1 *       AND NPOINTS IS THE NUMBER OF POINTS COUNTED                    *
0033    1 ************************************************************************
0034    1       INTEGER*2 ICOD(0:2)
0035    1       DIMENSION COD(0:2)
0036    1       COMMON/CODE/ICOD,COD,SSUM,ZSUM,NSLOPES,NPOINTS
0037    1 ************************************************************
0038      *
0039            NSLOPES=0
0040            NPOINTS=0
0041            ZSUM=0
0042            SSUM=0
0043            DO I=0,2
0044               ICOD(I)=0
0045            ENDDO
0046      *
0047      *       FOR EACH N-S SCAN LINE INTERSECTING THE CIRCLE
0048      *
0049            INTX=NINT(X/DBRES)*DBRES
0050            INTY=NINT(Y/DBRES)*DBRES
0051                DO IX=INTX-HEXR,INTX+HEXR,DBRES
0052                  YDELTA=NINT(SQRT(RAD2-(IX-INTX)**2)/DBRES)*DBRES
0053      *           YDELTA IS THE DISTANCE (ROUNDED TO DBRES)TO THE
0054      *           CIRCUMFERENCE
0055      *           FOR EACH POINT ON THE SCAN LINE,FROM S TO N
0056                  DO IY=INTY-YDELTA,INTY+YDELTA,DBRES
0057                    J=(IX-SWX)/DBRES+1
```

```
0058                      I=(IY-SWY)/DRRES+1
0059                      CALL SUMMER(I,J)
0060                    ENDDO
0061     *              NEXT POINT
0062                  ENDDO
0063     *            NEXT SCAN
0064     *        NEXT HEX#
0065             IF(NPOINTS.NE.0)CALL AVG(HXNO,X,Y)
0066             RETURN
0067             END
```

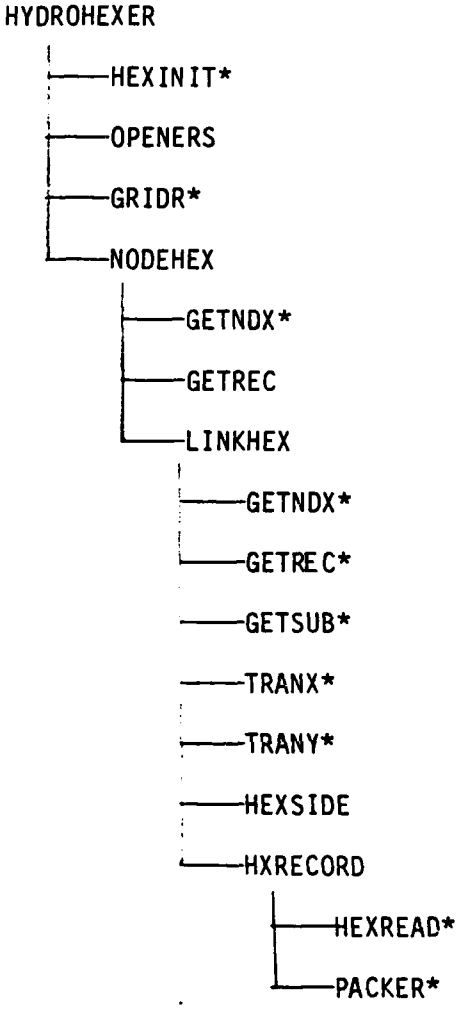
```
0001              PROGRAM HEXER
0002     ************************************************************
0003     *        'HEXISES' THE SURFACE AND ELEVATION DATA          *
0004     ************************************************************
0005              IMPLICIT INTEGER(H,P)
0006              LOGICAL*1 BETWEEN
0007              INCLUDE 'MAXMIN.CMN'
0008    1 ************************************************************
0009    1 *        THE UTM LIMITS OF THE RECTANGLE OF INTEREST       *
0010    1 ************************************************************
0011    1         INTEGER XMIN,XMAX,YMIN,YMAX
0012    1         COMMON /MAXMIN/XMIN,XMAX,YMIN,YMAX
0013    1 ************************************************************
0014              INCLUDE 'CORNER.CMN'
0015    1 ************************************************************
0016    1 *        SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE  *
0017    1 *        AREA REPRESENTED BY THE DATA IN IBUF.             *
0018    1 ************************************************************
0019    1         INTEGER*4 SWX,SWY
0020    1         COMMON/CORNER/SWX,SWY
0021    1 ************************************************************
0022              DIMENSION HEX6(2401),HEX4(49)
0023              CALL HEXINIT
0024              CALL CORNERS
0025              CALL HEXGEN(HX6,HEX6,10,6)    !GET ALL LEVEL 6 CENTERS
0026              CALL HEXGEN(HX4,HEX4,6,4)     !GET CENTER LEVEL 6
0027              DO I=1,HX6
0028                 CALL HEX2XY(HEX6(I),X,Y)
0029                 IF(BETWEEN(X,XMIN,XMAX).AND.BETWEEN(Y,YMIN,YMAX))THEN
0030                   SWX=NINT(X/10000.)*10000-20000
0031                   SWY=NINT(Y/10000.)*10000-20000
0032                   CALL UNGEN
0033                   DO J=1,HX4
0034                      HEX=HXADD(HEX6(I),HEX4(J))
0035                      CALL HEX2XY(HEX,X,Y)
0036                      CALL HEXOUT(HEX,1,H)
0037                      CALL GATOR(X,Y,H)
0038                   ENDDO
0039                 ENDIF
0040              ENDDO
0041              PRINT*,'TH-IH-THATS ALL F-FOLKS.'
0042              END
```

```
0001              SUBROUTINE HEXGEN(HXN,HXNO,LEVTOP,LEVBOT)
0002      ************************************************************
0003      *       THIS ROUTINE GENERATES HEX NUMBERS                 *
0004      *       FROM LEVEL 'LEVTOP' TO 'LEVBOT',                   *
0005      *       NESTED IN HEX FASHION.                             *
0006      ************************************************************
0007      *       INPUTS: LEVTOP,LEVBOT-- THE TOP AND BOTTOM LEVELS  *
0008      *                 OF THE HEX TREE TO BE GENERATED          *
0009      *       OUTPUTS:  HXN-- THE NUMBER OF HEXES GENERATED      *
0010      *                 HXNO-- THE ARRAY CONTAINING THE HEX NUMBERS *
0011      ************************************************************
0012              IMPLICIT INTEGER (H,P)
0013              DIMENSION LEVSTOP(4:10)
0014              DIMENSION HXNO(2401)
0015              INTEGER*4 ZERO
0016      C...    THE VARIABLE 'LEVMIN' SHOULD BE (AND PROBABLY IS) SET ELSEWH
0017              LEVMIN=4
0018              ZERO=77777777
0019              L=LEVTOP-LEVBOT
0020              IF(L.EQ.0)THEN
0021                PRINT*,'ERROR IN HEXGEN'
0022                RETURN
0023              ENDIF
0024              HXN=7**(L-1)  !YOU MUST ASK FOR AT LEAST ONE LEVEL
0025 C  D         PRINT*,'HXN',HXN
0026              DO I=4,10
0027                 LEVSTOP(I)=0
0028              ENDDO
0029              DO I=LEVBOT,LEVTOP-1
0030                 LEVSTOP(I)=6
0031              ENDDO
0032              HXN=0
0033      C...    IF LEVSTOP(LEVEL)=0 THE LOOP IS ONLY EXECUTED ONCE, AND
0034      C...    THE DIGIT SUBTRACTED IS 0,..NO CHANGE
0035              DO LEV10=0,LEVSTOP(10)
0036                   L10=LEV10*1000000
0037                   DO LEV9=0,LEVSTOP(9)
0038                      L9=LEV9*100000
0039                      DO LEV8=0,LEVSTOP(8)
0040                         L8=LEV8*10000
0041                         DO LEV7=0,LEVSTOP(7)
0042                           L7=LEV7*1000
0043                           DO LEV6=0,LEVSTOP(6)
0044                              L6=LEV6*100
0045                              DO LEV5=0,LEVSTOP(5)
0046                                 L5=10*LEV5
0047                                 DO LEV4=0,LEVSTOP(4)
0048                                    L4=LEV4
0049                                    HXN=HXN+1
0050                                    HXNO(HXN)=ZERO-L10-L9-L8-L7-L6-L5-L4
0051 C  D                                  PRINT*,HXN,HXNO(HXN)
0052                                 ENDDO
0053                              ENDDO
0054                           ENDDO
0055                         ENDDO
0056                      ENDDO
0057                   ENDDO
```

```
0058                     ENDDO
0059 C   D          PRINT*,HXN,(HXNO(I),I=1,HXN)
0060               DO N=1,HXN
0061                  CALL HEXIN(HXNO(N),1,LEVMIN,HSTOP)
0062                  HXNO(N)=HSTOR
0063               ENDDO
0064               RETURN
0065               END
```

```
0001            SUBROUTINE SUMMER(I,J)
0002      ************************************************************
0003      *       SUMS THE ELEVATION,SLOPE,AND FEATURE DATA AT ONE POINT *
0004      ************************************************************
0005      *       INPUTS: I,J-- THE ROW AND COLUMN IN THE ARRAY IBUF     *
0006      ************************************************************
0007            IMPLICIT INTEGER*2 (H-P)
0008            INCLUDE 'HEXRAD.CMN'
0009    1       INTEGER*2 DBRES,HEXR
0010    1       COMMON/HEXRAD/DBRES,RAD2,HEXR
0011            INCLUDE 'CODE.CMN'
0012    1 ************************************************************
0013    1 *       ICOD CONTAINS THE COUNTS OF THE RESPECTIVE SURFACE CODES *
0014    1 *       COD CONTAINS THE RESPECTIVE PERCENTAGES                *
0015    1 *       SSUM IS THE SUM OF THE ABSOLUTE SLOPES                 *
0016    1 *       ZSUM IS THE SUM OF THE ELEVATIONS                      *
0017    1 *       NSLOPES IS THE NUMBER OF SLOPES COUNTED                *
0018    1 *       AND NPOINTS IS THE NUMBER OF POINTS COUNTED            *
0019    1 ************************************************************
0020    1       INTEGER*2 ICOD(0:2)
0021    1       DIMENSION COD(0:2)
0022    1       COMMON/CODE/ICOD,COD,SSUM,ZSUM,NSLOPES,NPOINTS
0023    1 ************************************************************
0024      C...  COMPUTE THE ABSOLUTE DIFFERENCE IN
0025      C...  ELEVATIONS BETWEEN THIS POINT AND THE
0026      C...  POINTS ADJACENT TO THE N AND E
0027      C...  ADD TO THE CUMULATIVE SUMS OF DIFFERENCES
0028      C...  AND ELEVATIONS,RESPECTIVELY
0029            Z1=IELV(I,J)
0030            IF(Z1.LE.0.OR.Z1.GE.4000)RETURN
0031      C...  INCREASE THE POINT COUNT
0032            NPOINTS=NPOINTS+1
0033      C
0034      C...  INCREASE THE FEATURE CODE TALLIES
0035            IC=ICODE(I,J)
0036            IF(IC.NE.1.AND.IC.NE.2) IC=0
0037            ICOD(IC)=ICOD(IC)+1
0038      C
0039            ZSUM=ZSUM+Z1
0040            IF(J+1.GT.400)GOTO30    !400 COLUMNS IN THE ARRAY
0041            Z2=IELV(I,J+1)
0042            IF(Z2.LE.0.OR.Z2.GE.4000)GOTO30
0043            NSLOPES=NSLOPES+1
0044            SSUM=SSUM+ABS(Z1-Z2)
0045      30    CONTINUE
0046            IF(I+1.GT.400)RETURN    !400 ROWS IN THE ARRAY
0047            Z3=IELV(I+1,J)
0048            IF(Z3.LE.0.OR.Z3.GE.4000)RETURN
0049            NSLOPES=NSLOPES+1
0050            SSUM=SSUM+ABS(Z1-Z3)
0051            RETURN
0052            END
```

HYDROHEXER CALLING SEQUENCE



*TERRAIN SYSTEM UTILITIES

Figure B-9.

PROGRAM: HYDROHEXER

ROUTINE \ COMMON	CENTER	HEX	HEXRAD	LNKNOD	PACK	SUB	TRAN
GETSUB				X		X	
GRIDR				X			
HEXINIT		X	X				
HEXSIDE							X
HXRECORD					X		
HYDROHEXR	X			X			X
LINKHEX	X			X	X	X	
NODEHEX				X		X	
PACKER					X		

Figure B-10

```
0001            SUBROUTINE HEXSIDE(X,Y,HS,HN,W,Z)
0002      ************************************************************
0003      *       THIS SUBROUTINE DETERMINES THE HEX NUMBER           *
0004      *       THAT ANY X,Y COORDINATES LIES WITHIN. THEN          *
0005      *       IT DETERMINES THE SIDE OF THE HEX THAT IS           *
0006      *       NEAREST THE COORDINATES.                            *
0007      ************************************************************
0008      *       INPUTS:                                             *
0009      *              X,Y-- EASTING,NORTHING IN METERS             *
0010      *       OUTPUTS:                                            *
0011      *              HS-- HEX SIDE                                *
0012      *              HN-- HEX NUMBER                              *
0013      *              W,Z-- COORDINATES OF CENTER OF HEX IN        *
0014      *                    METERS FROM CENTER OF HEX ORIGIN       *
0015      ************************************************************
0016      *       AT=HORIZONTAL DISTANCE OF THE POINT FROM THE        *
0017      *          HEX CENTER.                                      *
0018      *       BT=VERTICAL DISTANCE OF THE POINT FROM THE          *
0019      *          HEX CENTER.                                      *
0020      *       A AND B ARE THE COORDINATES OF THE POINT RELATIVE   *
0021      *       TO A ROTATION OF THE COORDINATE SYSTEM.             *
0022      *       C=THE COSINE OF THE ANGLE OF ROTATION.              *
0023      *       S=THE SINE OF THE ANGLE OF ROTATION.                *
0024      *       D=TAN(60)*A=SQRT(3)*A                               *
0025      *         THE SIDE OF THE HEX THE POINT IS NEAREST CAN      *
0026      *       BE DETERMINED BY ITS ANGLE FROM THE HORIZONTAL      *
0027      *       AXIS.                                               *
0028      *       SIDE3:0-60  SIDE1:60-120  SIDE5:120-180             *
0029      *       SIDE4:180-240  SIDE6:240-300  SIDE2:300-360         *
0030      *         THE POINT IS WITHIN 60 DEGREES OF THE             *
0031      *       HORIZONTAL AXIS IF ABS(B/A)<TAN(60)=SQRT(3).        *
0032      *       THEREFORE:                                          *
0033      *       IF 0<B<D, THEN 0-60 DEGREES.                        *
0034      *       IF 0<B<-D, THEN 120-180 DEGREES.                    *
0035      *       IF 0<B AND NEITHER OF ABOVE, THEN 60-120 DEGREES.   *
0036      *       IF D<B<0, THEN 180-240 DEGREES.                     *
0037      *       IF -D<B<0, THEN 300-360 DEGREES.                    *
0038      *       IF B<0 AND NEITHER OF ABOVE, THEN 240-300 DEGREES.  *
0039      ************************************************************
0040            IMPLICIT INTEGER (H,P)
0041            INCLUDE 'TRAN.CMN'
0042     1      COMMON/TRAN/S,C,L,SQ3
0043            CALL XYL2HA(X,Y,L,HN)
0044            CALL HA2XYL(HN,W,Z,L)
0045            AT=X-W
0046            BT=Y-Z
0047            A=C*AT+S*BT
0048            B=C*BT-S*AT
0049            D=SQ3*A
0050            IF(B.GE.0) THEN
0051              IF(B.LE.D) THEN
0052                HS=3
0053                ELSE IF(B.LE.-D) THEN
0054                HS=5
0055                ELSE
0056                HS=1
0057              END IF
```

```
0058                ELSE IF(B.GE.-D) THEN
0059                HS=2
0060                ELSE IF(B.GE.D) THEN
0061                HS=4
0062                ELSE
0063                HS=6
0064              END IF
0065            RETURN
0066            END
```

```
0001              SUBROUTINE HXRECORD(HA,HSIDE,IERR)
0002        ************************************************************
0003        *       RECORDS THE HYDRO CODE 'LTYPE' AT SIDE 'HSIDE' OF  *
0004        *       THE HEX 'HA'.  THEN IT FINDS THE ADJACENT HEX AND  *
0005        *       THE CORRESPONDING SIDE AND RE-RECORDS THE INFO.    *
0006        ************************************************************
0007        *       INPUT:  HA--THE HEX ADDRESS OF THE FIRST SUBNODE   *
0008        *               HSIDE-- THE SIDE OF HEX 'HA' AT WHICH THE  *
0009        *                       HYDRO CODE IS BEING RECORDED       *
0010        *       OUTPUT:  IERR-- AN ERROR FLAG                      *
0011        ************************************************************
0012              IMPLICIT INTEGER(H,P)
0013              INCLUDE 'UTIL:PACK.CMN'
0014      1 ************************************************************
0015      1       INTEGER*4 SIDES ! PACKED CONNECTIVITIES            *
0016      1       INTEGER*4 LTYPE ! CONNECTIVITY FOR CURRENT SIDE    *
0017      1       COMMON/PACK/SIDES,LTYPE
0018      1 ************************************************************
0019              LU=7  ! LOGICAL UNIT FOR HEX FILE
0020        *     PUT THE SIDE INDICATOR INTO INTERNAL HEX FORMAT
0021              CALL HEXIN(HSIDE,1,4,HSTORA)
0022        *     FIND THE ADJACENT HEX BY ADDITION
0023              HB=HXADD(HA,HSTORA)
0024        *     FIND THE INVERSE OF THE SIDE
0025              HSTORB=HXINV(HSTORA)
0026        *
0027        *     GET THE RECORD FOR HEX 'HA' OR CAUSE IT TO
0028        *     BE INITIALIZED IF NECESSARY
0029              CALL HEXREAD(HA,SIDES,LU)
0030        *
0031              CALL PACKER(HA,HSTORA,LU,IERR)
0032              IF (IERR.EQ.0)RETURN
0033        *
0034        *     NOW FOR THE SECOND HEX
0035              CALL HEXREAD(HB,SIDES,LU)
0036              CALL PACKER(HB,HSTORB,LU,IERR)
0037              RETURN
0038              END
```

```
0001              PROGRAM HYDROHEXR
0002      ************************************************
0003      *       THE SET OF ROUTINES USED TO 'HEXISE' THE   *
0004      *       BDM-PRODUCED GERMAN HYDROGRAPHY DATA.      *
0005      ************************************************
0006              IMPLICIT INTEGER(H,P)
0007              INTEGER*4 X0,Y0
0008              INCLUDE 'TRAN.CMN'
0009     1        COMMON/TRAN/S,C,L,SQ3
0010              INCLUDE 'UTIL:LNKNOD.CMN'
0011     1 ********************************************************************
0012     1 *       ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES            *
0013     1 ********************************************************************
0014     1        INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0015     1        COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0016     1      +  ,SUBREC(500)
0017     1 ********************************************************************
0018              INCLUDE 'UTIL:CENTER.CMN'
0019     1 ************************************************************
0020     1 *       THE CENTER OF THE HEX GRID IS AT XORIGIN,YORIGIN    *
0021     1 *       WHERE THE COORDINATES ARE IN METERS UTM RELATIVE    *
0022     1 *       TO A GIVEN GRID ZONE.                              *
0023     1 ************************************************************
0024     1        INTEGER*4 XORIGIN,YORIGIN
0025     1        COMMON/CENTER/XORIGIN,YORIGIN
0026     1        DATA XORIGIN/500000/,YORIGIN/5700000/
0027     1 ************************************************************
0028      *       INITIALIZE THE HEX PARAMETERS
0029              CALL HEXINIT
0030      *       OPEN THE LOC AND HEX FILES                          *
0031      *       INITIALIZING VARIABLES FOR USE IN  HEXSIDE          *
0032              SQ3=SQRT(3.)
0033              REALEV=LEVMIN
0034              ANGRAD=REALEV*19.11*3.14159/180.
0035              S=SIN(ANGRAD)
0036              C=COS(ANGRAD)
0037              L=4
0038      *       READ IN THE GRID POINTERS
0039              CALL GRIDR
0040              DO J=1,128
0041                 DO I=1,128
0042                    NODE=GRID(I,J)
0043                    IF(NODE.NE.0)CALL NODEHEX(NODE)
0044                 ENDDO
0045              ENDDO
0046      *
0047              END
```

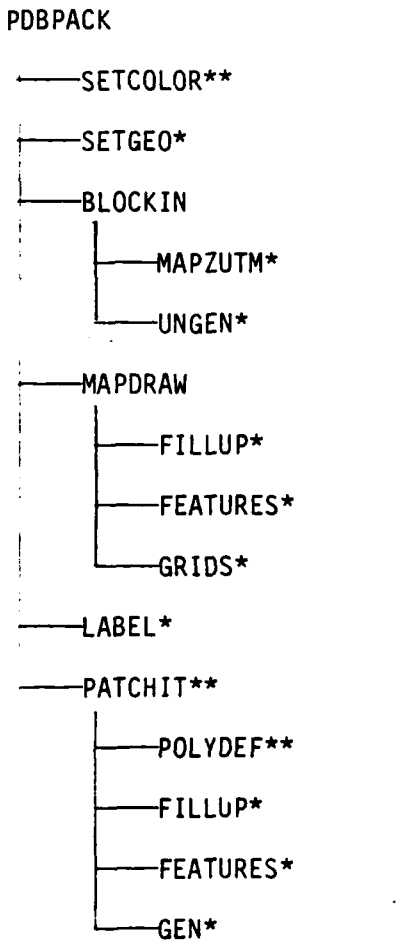
```
0001            SUBROUTINE LINKHEX(NODX,NODY,LNKNUM)
0002      ************************************************************
0003      *       THIS ROUTINE PROCESSES ONE 'OUTLINK',              *
0004      *       CAUSING EACH SUBNODE TO BE RECORDED AS A           *
0005      *       HYDRO CODE AT THE CLOSEST SIDE OF THE HEX          *
0006      *       WHICH CONTAINS THAT SUBNODE.                       *
0007      ************************************************************
0008      *       INPUT:                                             *
0009      *               LNKNUM--THE LINK NUMBER OF THE FIRST       *
0010      *                       LINK INCIDENT TO THIS NODE         *
0011      *             NODX,NODY-- EASTING,NORTHING IN METERS       *
0012      *                         OF THE START NODE                *
0013      ************************************************************
0014            IMPLICIT INTEGER (H,P)
0015            INTEGER*2 TMPLINK,TERMX,TERMY,NODX,NODY
0016            INTEGER*2 X(0:100),Y(0:100)
0017            INTEGER*4 WRDPOS,SRECNUM,SUBWRD,TERMXY
0018            INCLUDE 'UTIL:SUB.CMN'
0019      1 ************************************************************
0020      1 *       SUBX,SUBY THE X AND Y COORDINATES OF THE SUBNODES  *
0021      1 *       IN ONE LINK (SEE BDM DOCUMENTATION)                *
0022      1 ************************************************************
0023      1       INTEGER*2 SUBX(100),SUBY(100)
0024      1       COMMON/SUB/ SUBX,SUBY
0025      1 ************************************************************
0026            INCLUDE 'UTIL:PACK.CMN'
0027      1 ************************************************************
0028      1       INTEGER*4 SIDES ! PACKED CONNECTIVITIES            *
0029      1       INTEGER*4 LTYPE ! CONNECTIVITY FOR CURRENT SIDE    *
0030      1       COMMON/PACK/SIDES,LTYPE
0031      1 ************************************************************
0032            INCLUDE 'UTIL:LNKNOD.CMN'
0033      1 ************************************************************
0034      1 *       ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES    *
0035      1 ************************************************************
0036      1       INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0037      1       COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0038      1      +  ,SUBREC(500)
0039      1 ************************************************************
0040            INCLUDE 'UTIL:CENTER.CMN'
0041      1 ************************************************************
0042      1 *       THE CENTER OF THE HEX GRID IS AT XORIGIN,YORIGIN   *
0043      1 *       WHERE THE COORDINATES ARE IN METERS UTM RELATIVE    *
0044      1 *       TO A GIVEN GRID ZONE.                              *
0045      1 ************************************************************
0046      1       INTEGER*4 XORIGIN,YORIGIN
0047      1       COMMON/CENTER/XORIGIN,YORIGIN
0048      1       DATA XORIGIN/500000/,YORIGIN/5700000/
0049      1 ************************************************************
0050      *
0051            X(0)=NODX
0052            Y(0)=NODY
0053            NXTLNK=LNKNUM
0054            LU=3
0055            DO WHILE(NXTLNK.NE.0)
0056               CALL GETNDX(NXTLNK,LRECNUM,WRDPOS)
0057               CALL GETREC(LU,LRECNUM,LNKREC)
```

```
0058     *           SET THE TYPE
0059                 N=WRDPOS
0060     *
0061     *            SET LINK TYPE                          *
0062                  TMPLINK=LIBSEXTZV(0,16,LNKREC(3,N))
0063                  CALL LIBSINSV(TMPLINK,0,16,LTYPE)
0064     *
0065                   LTYPE=15-LTYPE
0066                   IF(LTYPE.LT.0.OR.LTYPE.GT.3)LTYPE=0
0067     *             EXTRACT THE TERMINAL COORDINATES      *
0068                   TERMXY=LNKREC(4,WRDPOS)
0069     *             THE X .......
0070                   TMP=LIBSEXTZV(0,16,TERMXY)
0071                   CALL LIBSINSV(TMP,0,16,TERMX)
0072     *             ..... AND THEN THE Y                  *
0073                   TMP=LIBSEXTZV(16,16,TERMXY)
0074                   CALL LIBSINSV(TMP,0,16,TERMY)
0075     *
0076     *            SET SUBNODE RECORD POINTER             *
0077                  TMPLINK=LIBSEXTZV(0,16,LNKREC(5,N))
0078                  CALL LIBSINSV(TMPLINK,0,16,SRECNUM)
0079     *            SET SUBNODE WORD POINTER               *
0080                  TMPLINK=LIBSEXTZV(16,16,LNKREC(5,N))
0081                  CALL LIBSINSV(TMPLINK,0,16,SUBWRD)
0082     *
0083     *                 IF THERE ARE SUBNODES             *
0084                       IF(SRECNUM.NE.0)THEN
0085     *                    GET THE SUBNODE LIST
0086                          CALL GETSUB(SRECNUM,SUBWRD,NUM)
0087     *                    PROCESS THE SUBNODE LIST       *
0088                          DO I=1,NUM
0089                             X(I)=SUBX(I)
0090                             Y(I)=SUBY(I)
0091                          ENDDO
0092                          X(NUM+1)=TERMX
0093                          Y(NUM+1)=TERMY
0094                          DO I=0,NUM+1
0095                             X1=TRANX(X(I))-XORIGIN
0096                             Y1=TRANY(Y(I))-YORIGIN
0097                             CALL HEXSIDE(X1,Y1,HS,HN,W,Z)
0098                             CALL HXRECORD(HN,HS,IADJ)
0099                          ENDDO
0100                       ENDIF
0101     *           GET THE NEXT LINK RECORD
0102                 NXTLNK=LNKREC(2,WRDPOS)
0103               ENDDO
0104               RETURN
0105               END
```

```
0001              SUBROUTINE NODEHEX(NODE)
0002     ************************************************
0003     *        THIS ROUTINE EXTRACTS THE I*4 WORD    *
0004     *        WHICH CONTAINS THE NODE CORDINATES    *
0005     *        AND THE RECORD # OF THE FIRST LINK    *
0006     *        WHICH IS INCIDENT TO THE NODE         *
0007     ************************************************
0008     *        INPUT:  NODE-- THE HEAD NODE FOR A    *
0009     *                       GRID RECORD FROM THE   *
0010     *                       LOC DATA BASE          *
0011     ************************************************
0012              IMPLICIT INTEGER (H,P)
0013              INTEGER*4 WRDPOS,TMP
0014              INTEGER*2 NODX,NODY
0015              INCLUDE 'UTIL:LNKNOD.CMN'
0016    1 ****************************************************************
0017    1 *        ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES       *
0018    1 ****************************************************************
0019    1         INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0020    1         COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0021    1       +  ,SUBREC(500)
0022    1 ****************************************************************
0023              INCLUDE 'UTIL:SUB.CMN'
0024    1 ************************************************************
0025    1 *        SUBX,SUBY THE X AND Y COORDINATES OF THE SUBNODES *
0026    1 *        IN ONE LINK (SEE BDM DOCUMENTATION)               *
0027    1 ************************************************************
0028    1         INTEGER*2 SUBX(100),SUBY(100)
0029    1         COMMON/SUB/ SUBX,SUBY
0030    1 ************************************************************
0031              DO WHILE (NODE.NE.0)
0032                 CALL GETNDX(NODE,NRECNUM,WRDPOS)
0033                 LU=2
0034                 CALL GETREC(LU,NRECNUM,NODREC)
0035     *
0036                 NODXY=NODREC(5,WRDPOS)
0037     *           SET THE X COORDINATE        *
0038                 TMP=LIB$EXTZV(0,16,NODXY)
0039                 CALL LIB$INSV(TMP,0,16,NODX)
0040     *           SET THE Y COORDINATE        *
0041                 TMP=LIB$EXTZV(16,16,NODXY)
0042                 CALL LIB$INSV(TMP,0,16,NODY)
0043     *
0044                 LNK=NODREC(4,WRDPOS)
0045                 CALL LINKHEX(NODX,NODY,LNK)
0046     *           GET NEXT NODE
0047                 NODE=NODREC(1,WRDPOS)
0048              ENDDO
0049              RETURN
0050              END
```

```
0001            SUBROUTINE OPENERS
0002      ************************************************************
0003      *       THIS ROUTINE SIMPLY OPENS THE GRID,NODE,LINK,AND   *
0004      *       SUBNODE FILES, AND THE ISAM FILE WHICH CONTAINS    *
0005      *       THE 'HEXISED' LOC OR HYDRO DATA                    *
0006      ************************************************************
0007              OPEN(UNIT=1,NAME='GRID',TYPE='OLD',READONLY,SHARED,
0008           *ACCESS='DIRECT',BLOCKSIZE=2000)
0009              OPEN(UNIT=2,NAME='NODE',TYPE='OLD',READONLY,SHARED,
0010           *ACCESS='DIRECT',BLOCKSIZE=2000)
0011              OPEN(UNIT=3,NAME='ROAD',TYPE='OLD',READONLY,SHARED,
0012           *ACCESS='DIRECT',BLOCKSIZE=2000)
0013              OPEN(UNIT=4,NAME='SUBN',TYPE='OLD',READONLY,SHARED,
0014           *ACCESS='DIRECT',BLOCKSIZE=2000)
0015      *
0016      *       NOW FOR THE ISAM FILE
0017              OPEN(UNIT=7,NAME='HEXROAD',STATUS='UNKNOWN',
0018           +  ORGANIZATION='INDEXED',ACCESS='KEYED',RECL=2,
0019           +  RECORDTYPE='FIXED',FORM='UNFORMATTED',
0020           +  KEY=(1:4:INTEGER))
0021              RETURN
0022              END
```

PDBPACk CALLING SEQUENCE



*TERRAIN SYSTEMS UTILITIES

**"SURFACE" ROUTINES

Figure B-11

PROGRAM: PDBPACK

ROUTINE \ COMMON	CMERID	CORNER	MAP	WINDE	ZDBPRO
BLOCKIN	X	X		X	
FILLUP		X	X	X	
GEN		X			
GRIDS				X	
LABEL				X	
MAPDRAW		X		X	
PATCHIT		X			
SETGEO	X				X
UNGEN		X			

Figure B-12

```
0001              SUBROUTINE BLOCKIN(MAP)
0002      ************************************************************
0003      *       THIS ROUTINE DETERMINES WHICH 10KM BLOCKS ARE      *
0004      *       NEEDED TO COVER A MAP AND CAUSES THESE TO BE       *
0005      *       READ IN.                                           *
0006      ************************************************************
0007      *       INPUTS: MAP-- THE NAME OF THE MAP TO BE READ IN    *
0008      *       OUTPUTS: NONE                                      *
0009      ************************************************************
0010              INCLUDE 'CORNER.CMN'
0011    1 ************************************************************
0012    1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE   *
0013    1 *       AREA IN THE ARRAY IBUF.                            *
0014    1         INTEGER*4 SWX,SWY
0015    1         COMMON/CORNER/SWX,SWY
0016    1 ************************************************************
0017              INCLUDE 'CMERID.CMN'
0018    1 ************************************************************
0019    1         REAL*8 CMERID
0020    1         REAL P_RAD
0021    1         COMMON/CMERID/CMERID,P_RAD
0022    1 ************************************************************
0023              INCLUDE '[TERRAIN.SURFACE]WINDO.CMN'
0024    1 ************************************************************
0025    1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND  *
0026    1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER   *
0027    1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS *
0028    1 *       THE CONTOUR INTERVAL.                                *
0029    1 ************************************************************
0030    1         DIMENSION FWINXY(4)
0031    1         COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0032    1 ************************************************************
0033              CHARACTER*5 MAP
0034              CHARACTER*7 UTMSW,UTMNE
0035
0036              CALL MAP2UTM(MAP,FEAST,FNORTH,CMERID)
0037              IEAST=NINT(FEAST/10000.)*10000
0038              NORTH=NINT(FNORTH/10000.)*10000
0039 C   D        PRINT*,IEAST,NORTH
0040              SWX=IEAST-20000 ! MAP2UTM RETURNS THE CENTER
0041              SWY=NORTH-20000  !AND A 40KM SQUARE IS NEEDED
0042              CALL UNGEN      !UNGEN CAUSES THE DATA TO BE READ IN
0043              FWINXY(1)=SWX
0044              FWINXY(2)=FWINXY(1)+40000
0045              FWINXY(3)=SWY
0046              FWINXY(4)=FWINXY(3)+40000
0047 C   D        PRINT*,FWINXY
0048 C   D        READ*,JUNK
0049              RETURN
0050              END
```

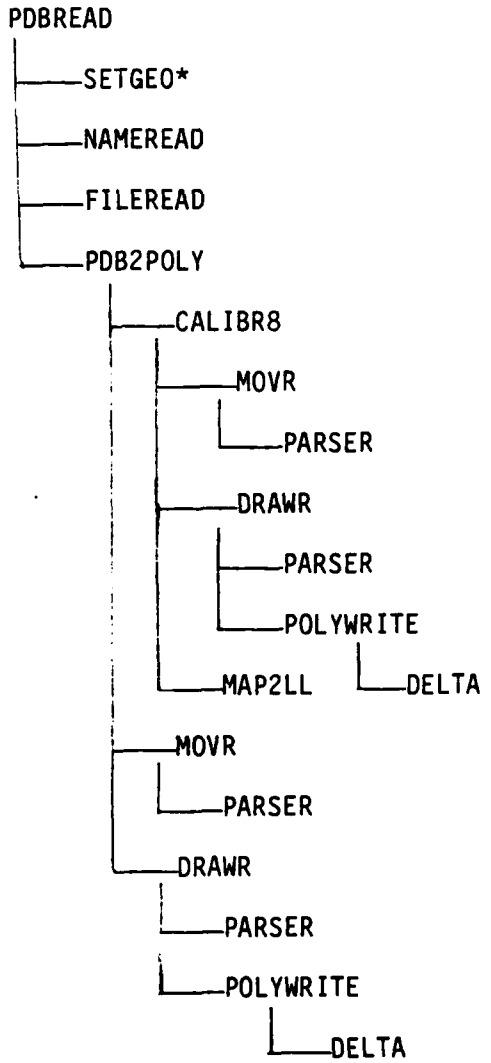
```
0001            SUBROUTINE MAPDRAW(MAP,ERR)
0002      ************************************************************
0003      *       THIS ROUTINE DISPLAYS AND FILLS THE DATA FROM      *
0004      *       ONE MAPSHEET.                                      *
0005      ************************************************************
0006      *       INPUTS: MAP-- THE NAME OF THE MAP IN THE M745      *
0007      *                     SERIES                               *
0008      *       OUTPUTS: ERR-- AN ERROR FLAG                       *
0009      ************************************************************
0010            LOGICAL*1 ERR
0011            DIMENSION PX(500),PY(500)
0012            DIMENSION POLY(500,2)
0013            CHARACTER*5 FNAME(2)
0014            CHARACTER*5 MAP
0015            CHARACTER*1 PREFIX(2)
0016            INTEGER*2 ICLR
0017            INCLUDE '[TERRAIN.SURFACE]WINDO.CMN'
0018     1 ************************************************************
0019     1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND  *
0020     1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER   *
0021     1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS *
0022     1 *       THE CONTOUR INTERVAL.                                *
0023     1 ************************************************************
0024     1       DIMENSION FWINXY(4)
0025     1       COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0026     1 ************************************************************
0027            INCLUDE 'CORNER.CMN'
0028     1 ************************************************************
0029     1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE   *
0030     1 *       AREA IN THE ARRAY IBUF.                            *
0031     1       INTEGER*4 SWX,SWY
0032     1       COMMON/CORNER/SWX,SWY
0033     1 ************************************************************
0034            DATA PREFIX/'F','U'/
0035            EQUIVALENCE (POLY(1,1),PX(1))
0036            EQUIVALENCE (POLY(1,2),PY(1))
0037            LU=2
0038            DO ICLR=1,2
0039              MAP(1:1)=PREFIX(ICLR)
0040              OPEN(NAME=MAP,UNIT=LU,STATUS='OLD',FORM='UNFORMATTED',ERR=
0041              X=1     !JUST TO CAUSE A READ TO EOF
0042              DO WHILE (X.EQ.1)
0043                 READ(LU,END=100)N,(PX(K),PY(K),K=1,N)
0044                 DO J=1,N
0045                    PX(J)=PX(J)-SWX
0046                    PY(J)=PY(J)-SWY
0047                 ENDDO
0048                 CALL FILLUP(N,POLY,ICLR)
0049
0050              ENDDO
0051    100       CLOSE(UNIT=LU)
0052            ENDDO
0053    C...    FILLUP CHANGES THE WINDOW SETTING,SO...
0054            FWINXY(1)=SWX
0055            FWINXY(2)=SWX+40000
0056            FWINXY(3)=SWY
0057            FWINXY(4)=SWY+40000
```

MAPDRAW

```
0058              INCR=2
0059              CALL FEATURES(INCR)
0060              CALL LINCLR(4)
0061              CALL GRIDS
0062              RETURN
0063     200      CALL CMCLOS
0064              ERR=.TRUE.
0065              CLOSE(UNIT=LU)
0066              PRINT*,'ERROR IN MAP: ',MAP
0067              RETURN
0068              END
```

```
0001            PROGRAM PDBPACK
0002    ************************************************************
0003    *       THIS ROUTINE PACKS THE POLYGONAL AREAL DATA FROM    *
0004    *       PDBREAD INTO THE 10KM TERRAIN FILES                 *
0005    ************************************************************
0006            CHARACTER*5 NAM
0007            LOGICAL*1 ERR
0008            DATA ERR/.FALSE./
0009            CALL SETCOLOR
0010            CALL SETGEO
0011            DO WHILE (.NOT.ERR)
0012              PRINT*,'MAP?'
0013    10        FORMAT(A5)
0014              READ(5,10)NAM
0015              CALL BLOCKIN(NAM)
0016              CALL MAPDRAW(NAM,ERR)
0017              CALL CMOPEN
0018              CALL NEWPAG
0019              CALL LABEL
0020              CALL PATCHIT
0021            ENDDO
0022            END
```

PDBREAD CALLING SEQUENCE



*Terrain System Utility

Figure B-13

PROGRAM: PDBREAD

ROUTINE \ COMMON	CMERID	MAPDAT	WORDS	ZDBPRO
CALIBR8		X	X	
DRAWR		X	X	
FILEREAD			X	
MOVR		X	X	
PARSER			X	
PDB2POLY		X	X	
PDBREAD			X	
POLYWRITE	X	X		
SETGEO	X			X

Figure B-14

```
0001            SUBROUTINE CALIBR8(FNAME,FDM,ERR)
0002      ************************************************************
0003      *       THIS SUBROUTINE CHECKS THE HEADER FDM, THE SKEW-   *
0004      *       CORRECTION FDM, AND SETS THE X- AND Y-CALIBRATION  *
0005      ************************************************************
0006      *       INPUTS: FNAME-- THE NAME OF AN M745-SERIES MAP,    *
0007      *                 WITH A 'U' OR 'F' (URBAN OR FOREST) AS THE *
0008      *                 FIRST CHARACTER.                           *
0009      *       OUTPUTS: FDM-- FUNCTION DEFINITION MODULE TYPE     *
0010      ************************************************************
0011            LOGICAL ERR
0012            CHARACTER*5 FNAME
0013           -DIMENSION XX(4),YY(4)
0014            INCLUDE 'MAPDAT.CMN'
0015     1 ************************************************************
0016     1      REAL X,Y      !CURSOR POSITION
0017     1      REAL XCENTR,YCENTR !UTM CENTER OF MAP
0018     1      REAL XSCALE,YSCALE !METERS/TABLET UNIT
0019     1 ************************************************************
0020     1      COMMON/MAPDAT/X,Y,XCNTR,YCNTR,XSCALE,YSCALE
0021     1 ************************************************************
0022     1
0023     1
0024            INCLUDE 'WORDS.CMN'
0025     1 ************************************************************
0026     1      INTEGER*2 PTR          !POINTS TO CURRENT BYTE
0027     1      INTEGER*2 N_BYTES      !NUMBER OF BYTES IN FILE
0028     1      BYTE BYTES(11264)       !44 BLOCKS ON THE 4081
0029     1      INTEGER*2 WORDS(5632)!THE MAP COORDINATES ARE I*2
0030     1      EQUIVALENCE (WORDS(1),BYTES(1))
0031     1      COMMON/WORDS/BYTES,N_BYTES,PTR
0032     1 ************************************************************
0033     1
0034            INCLUDE 'FDM.PAR'
0035     1 ************************************************************
0036     1      INTEGER*2 FDM,L_R_M,L_R_D,S_R_M,S_R_D
0037     1      PARAMETER(
0038     1     +  HEADER=16,          !CODE FOR THE HEADER MODULE
0039     1     +  L_R_M= 28,          !LONG RELATIVE MOVE
0040     1     +  L_R_D= 29,          !LONG RELATIVE DRAW
0041     1     +  S_R_M= 32,          !SHORT RELATIVE MOVE
0042     1     +  S_R_D= 33)          !SHORT RELATIVE DRAW
0043     1 ************************************************************
0044       C...     CHECK HEADER FDM
0045                IF(BYTES(2).NE.HEADER.OR.BYTES(1).NE.14)THEN
0046                  WRITE(3,1) FNAME,BYTES(2),BYTES(1)
0047     1            FORMAT(1X,'BAD HEADER FDM IN : ',A5,2I2)
0048                  ERR=.TRUE.
0049                  RETURN
0050                ENDIF
0051       C...     RESETTING THE CURSOR POSITIONS.
0052                X=0
0053                Y=0
0054
0055       C...     CHECK FOR SKEW CORRECTION MOVES
0056                PTR=16
0057                FDM=BYTES(PTR)
```

```
0058              IF(FDM.EQ.L_R_M)THEN
0059                PTR=17
0060                CALL MOVR(FDM,ERR)
0061                IF(ERR)RETURN
0062              ELSE
0063                ERR=.TRUE.
0064                RETURN
0065              ENDIF
0066
0067       C...   CHECK CALIBRATION FDM
0068       C...   SETTING THE SCALE TO 1 STOPS THE INFO FROM
0069       C...   BEING WRITTEN BY POLYWRITE
0070              XSCALE=1
0071              YSCALE=1
0072              IF(FDM.EQ.L_R_D)THEN
0073                CALL DRAWR(FDM,ERR)
0074              ELSE
0075                WRITE(3,*)'BAD CALIBRATION'
0076                ERR=.TRUE.
0077                RETURN
0078              ENDIF
0079
0080       C...   ORIGINALLY THE CALIBRATIONS WERE SET FROM THE
0081       C...   DIGITIZED 10KM LINES
0082       C...   RESET THE X- AND Y-SCALES
0083       C...   THE MAPSHEETS ARE 20 X 12 MINUTES, AND THE
0084       C...   DIGITIZER TABLET WINDOW IS 10000 X 7500, SO...
0085              XSCALE=.000033333
0086              YSCALE=.000026667
0087              ERR=.FALSE.
0088       C...   SET UTM CENTER OF MAP
0089              CALL MAP2LL(FNAME,XCNTR,YCNTR)
0090 C     D       PRINT*,'CNTR IN CALIBR8: ',XCNTR,YCNTR
0091              RETURN
0092              END
```

```
0001            FUNCTION DELTA(X1,Y1,X2,Y2)
0002      ************************************************************
0003      *       THIS FUNCTION COMPUTES THE DISTANCE BETWEEN THE POINTS *
0004      *       (X1,Y2) AND (X2,Y2).                                   *
0005      ************************************************************
0006            D=(X1-X2)**2+(Y1-Y2)**2
0007            DELTA=SQRT(D)
0008            RETURN
0009            END
```

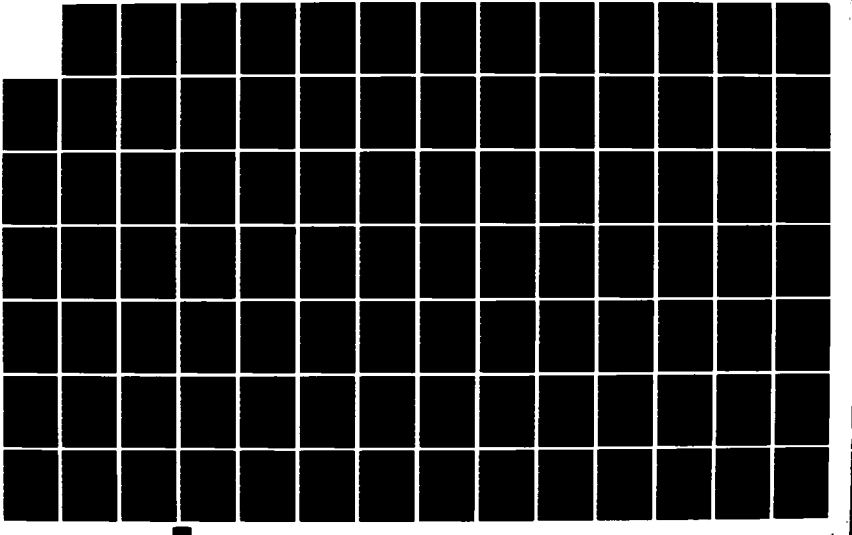
```
0001            SUBROUTINE DRAWR(FD ,ERR)
0002      ************************************************************
0003      *       PUTS THE PARSED MOVES INTO POLY AND CALLS POLYWRITE *
0004      *       IF THE NEXT FDM INDICATES A MOVE.                   *
0005      ************************************************************
0006            LOGICAL ERR
0007            REAL POLY(1000,2)
0008            INTEGER*2 P,ARRAY(1200),W_LEN
0009            INCLUDE 'MAPDAT.CMN'
0010    1 ************************************************************
0011    1       REAL X,Y      !CURSOR POSITION
0012    1       REAL XCENTR,YCENTR !UTM CENTER OF MAP
0013    1       REAL XSCALE,YSCALE !METERS/TABLET UNIT
0014    1 ************************************************************
0015    1       COMMON/MAPDAT/X,Y,XCNTR,YCNTR,XSCALE,YSCALE
0016    1 ************************************************************
0017    1
0018    1
0019            INCLUDE 'WORDS.CMN'
0020    1 ************************************************************
0021    1       INTEGER*2 PTR         !POINTS TO CURRENT BYTE
0022    1       INTEGER*2 N_BYTES     !NUMBER OF BYTES IN FILE
0023    1       BYTE BYTES(11264)      !44 BLOCKS ON THE 4081
0024    1       INTEGER*2 WORDS(5632)!THE MAP COORDINATES ARE I*2
0025    1       EQUIVALENCE (WORDS(1),BYTES(1))
0026    1       COMMON/WORDS/BYTES,N_BYTES,PTR
0027    1 ************************************************************
0028    1
0029            INCLUDE 'FDM.PAR'
0030    1 ************************************************************
0031    1       INTEGER*2 FDM,L_R_M,L_R_D,S_R_M,S_R_D
0032    1       PARAMETER(
0033    1     +  HEADER=16,          !CODE FOR THE HEADER MODULE
0034    1     +  L_R_M= 28,          !LONG RELATIVE MOVE
0035    1     +  L_R_D= 29,          !LONG RELATIVE DRAW
0036    1     +  S_R_M= 32,          !SHORT RELATIVE MOVE
0037    1     +  S_R_D= 33)          !SHORT RELATIVE DRAW
0038    1 ************************************************************
0039            DATA P/1/
0040            ERR=.FALSE.
0041            IP=(PTR-1)/2
0042            LEN=ISHFT(ISHFT(WORDS(IP),8),-8)-2  !2-BYTE HEADERS
0043            W_LEN=30/FDM+1        !OR 29 OR 31 OR 32...
0044            LEN=LEN/W_LEN
0045            CALL PARSER(ARRAY,W_LEN,LEN,ERR)
0046            IF(ERR)RETURN
0047            DO I=1,LEN,2
0048               POLY(P,1)=X
0049               POLY(P,2)=Y
0050               X=X+ARRAY(I)
0051               Y=Y+ARRAY(I+1)
0052               P=P+1
0053            ENDDO
0054             POLY(P,1)=X    !THE END OF THE LAST DRAW
0055             POLY(P,2)=Y
0056            FDM=BYTES(PTR)
0057            PTR=PTR+1
```

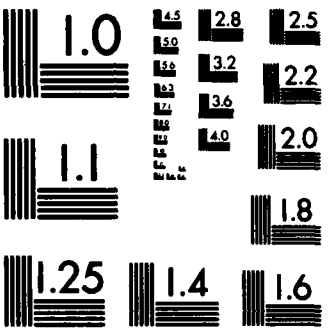
```
0058     C...     IF THE NEXT FDM IS A MOVE OR IF THIS IS THE END OF THE
0059     C...     INPUT FILE THEN WRITE THE CURRENT POLYGON.
0060              IF(FDM.EQ.L_R_M.OR.FDM.EQ.S_R_M.OR.PTR.GE.N_BYTES)THEN
0061                CALL POLYWRITE(POLY,P)
0062                P=1
0063              ENDIF
0064              RETURN
0065              END
```

```
0001
0002            SUBROUTINE FILEREAD(ERR)
0003     ************************************************************
0004     *      READS A PICTURE DATA BASE (PDB) FILE WHICH HAS BEEN    *
0005     *      TRANSFERRED FROM THE TEK 4081 AND PUTS IT INTO 'BYTES' *
0006     ************************************************************
0007            LOGICAL ERR
0008            INCLUDE 'WORDS.CMN'
0009   1 ************************************************************
0010   1        INTEGER*2 PTR          !POINTS TO CURRENT BYTE
0011   1        INTEGER*2 N_BYTES      !NUMBER OF BYTES IN FILE
0012   1        BYTE BYTES(11264)       !44 BLOCKS ON THE 4081
0013   1        INTEGER*2 WORDS(5632)!THE MAP COORDINATES ARE I*2
0014   1        EQUIVALENCE (WORDS(1),BYTES(1))
0015   1        COMMON/WORDS/BYTES,N_BYTES,PTR
0016   1 ************************************************************
0017   1
0018            ERR=.FALSE.
0019            N_BYTES=0
0020            DO WHILE(.NOT.ERR)
0021               READ(1,10,END=100,ERR=200)N,(BYTES(I),I=N_BYTES+1,N_BYTE
0022               N_BYTES=N_BYTES+N
0023            ENDDO
0024     10     FORMAT(Q,256A1)
0025     100    RETURN
0026     200    ERR=.TRUE.
0027            RETURN
0028            END
```

AD-A132 940 CORDIVEM EUROPEAN TERRAIN DATA(U) COMBINED ARMS OPERATIONS RESEARCH ACTIVITY FORT LEAVENWORTH KS W J THOMSON 1983 CAORA/TP-2-83 2/3

UNCLASSIFIED F/G 15/7 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
0001            SUBROUTINE MAP2LL(FNAME,FLON,FLAT)
0002      ************************************************
0003      *       THIS ROUTINE COMPUTES THE LAT,LON OF THE *
0004      *       CENTER OF A SHEET FROM THE M745 SERIES.  *
0005      ************************************************
0006      *       INPUTS: FNAME-- THE NAME OF THE MAP      *
0007      *       OUTPUTS: FLON,FLAT-- REAL-VALUED LAT AND *
0008      *                LON OF THE CENTER OF THE MAP    *
0009      ************************************************
0010            CHARACTER*5 FNAME
0011            DIMENSION D(2)
0012            PARAMETER PI=3.141592654
0013            P_RAD=PI/180.
0014
0015            DO I=2,4,2
0016               DECODE(2,10,FNAME(I:I+1)) D(I/2)
0017            ENDDO
0018      10    FORMAT(F3.0)
0019
0020            DLAT=50+(59-D(1))/2.*.2+.1
0021            DLON=9+(D(2)-20)/2./3.+1./6.
0022            FLAT=DLAT*P_RAD
0023            FLON=DLON*P_RAD
0024            RETURN
0025            END
```

```
0001              SUBROUTINE MOVR(FDM,ERR)
0002        ************************************************************
0003        *       RECOMPUTES THE CURSOR POSITION AND INDEX AFTER A   *
0004        *       RELATIVE MOVE HAS BEEN PARSED.                     *
0005        ************************************************************
0006        *       INPUTS: FDM-- THE CODE FOR THE FDM TYPE            *
0007        *       OUTPUTS: ERR-- ERROR FLAG                          *
0008        ************************************************************
0009              LOGICAL ERR
0010              INTEGER*2 FDM,W_LEN,LEN,ARRAY(20)!MOVES SHOULD BE SHORT
0011              INCLUDE 'MAPDAT.CMN'
0012      1 ************************************************************
0013      1       REAL X,Y      !CURSOR POSITION
0014      1       REAL XCENTR,YCENTR !UTM CENTER OF MAP
0015      1       REAL XSCALE,YSCALE !METERS/TABLET UNIT
0016      1 ************************************************************
0017      1       COMMON/MAPDAT/X,Y,XCNTR,YCNTR,XSCALE,YSCALE
0018      1 ************************************************************
0019      1
0020      1
0021              INCLUDE 'WORDS.CMN'
0022      1 ************************************************************
0023      1       INTEGER*2 PTR          !POINTS TO CURRENT BYTE
0024      1       INTEGER*2 N_BYTES      !NUMBER OF BYTES IN FILE
0025      1       BYTE BYTES(11264)       !44 BLOCKS ON THE 4081
0026      1       INTEGER*2 WORDS(5632)!THE MAP COORDINATES ARE I*2
0027      1       EQUIVALENCE (WORDS(1),BYTES(1))
0028      1       COMMON/WORDS/BYTES,N_BYTES,PTR
0029      1 ************************************************************
0030      1
0031              ERR=.FALSE.
0032              LEN=BYTES(PTR-2)-2  !2-BYTE HEADERS
0033              W_LEN=30/FDM+1     !OR 29,OR 31 OR 32...
0034              LEN=LEN/W_LEN
0035              CALL PARSER(ARRAY,W_LEN,LEN,ERR)
0036              IF(ERR)RETURN
0037              DO I=1,LEN,2
0038                 X=X+ARRAY(I)
0039                 Y=Y+ARRAY(I+1)
0040              ENDDO
0041              FDM=BYTES(PTR)
0042              PTR=PTR+1
0043              RETURN
0044              END
```

```
0001            SUBROUTINE NAMEREAD(NAMEIN,EOF)
0002      ************************************************************
0003      *       READS FILE NAMES FOR PROCESSING OF FILES BY        *
0004      *       PDBREAD                                            *
0005      ************************************************************
0006      *       INPUTS: NONE                                       *
0007      *       OUTPUTS: NAMEIN-- NEXT FILE TO BE PROCESSED        *
0008      *                EOF-- FLAG SIGNALLING END OF NAME         *
0009      *                      FILE                                *
0010      ************************************************************
0011            CHARACTER*9 NAMEIN
0012            LOGICAL EOF
0013            EOF=.FALSE.
0014               READ(7,10,END=100)NAMEIN ! FOR007 CONTAINS
0015      10       FORMAT(A9)               ! THE FILE NAMES
0016            RETURN
0017      100   EOF=.TRUE.
0018            RETURN
0019            END
```

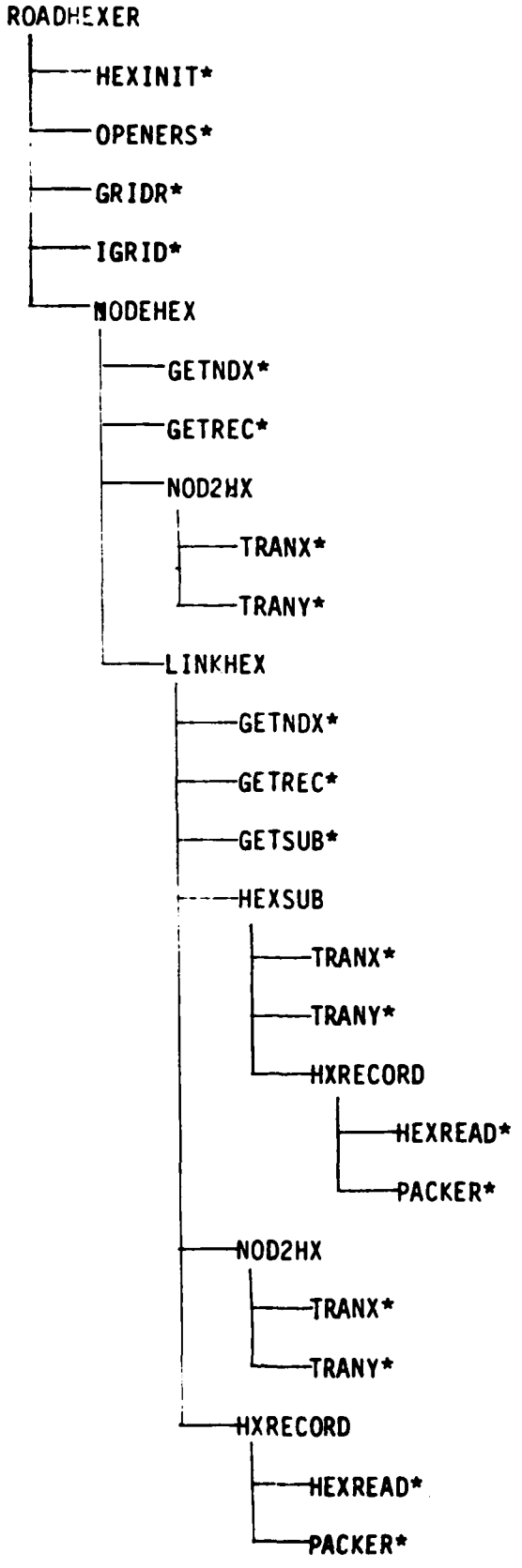
```
0001            SUBROUTINE PARSER(ARRAY,W_LEN,LEN,ERR)
0002      ****************************************************************
0003      *       'PARSES' THE CURRENT FDM (FUNCTION DEFINITION MODULE).  *
0004      ****************************************************************
0005      *       INPUTS:                                                 *
0006      *               W_LEN-- THE WORD LENGTH OF THE DATA(1 OR 2 BYTES) *
0007      *               LEN-- THE LENGTH OF THE ARRAY IN W_LEN UNITS    *
0008      *       OUTPUTS: ARRAY-- THE PARSED DATA                        *
0009      ****************************************************************
0010            INTEGER*2 W_LEN,LEN,ARRAY(0:LEN)
0011            LOGICAL ERR
0012            INCLUDE 'WORDS.CMN'
0013    1 ****************************************************************
0014    1       INTEGER*2 PTR          !POINTS TO CURRENT BYTE
0015    1       INTEGER*2 N_BYTES      !NUMBER OF BYTES IN FILE
0016    1       BYTE BYTES(11264)       !44 BLOCKS ON THE 4081
0017    1       INTEGER*2 WORDS(5632)!THE MAP COORDINATES ARE I*2
0018    1       EQUIVALENCE (WORDS(1),BYTES(1))
0019    1       COMMON/WORDS/BYTES,N_BYTES,PTR
0020    1 ****************************************************************
0021    1
0022            IF(W_LEN.EQ.1)THEN
0023              DO I=0,LEN-1,2
0024                 ARRAY(I)=BYTES(PTR+I+1)
0025                 ARRAY(I+1)=BYTES(PTR+I)
0026              ENDDO
0027            ELSE IF(W_LEN.EQ.2)THEN
0028              P=(PTR+1)/2
0029              DO I=0,LEN-1
0030                 ARRAY(I)=WORDS(P+I)
0031              ENDDO
0032            ELSE
0033              WRITE(3,*)'INVALID WORD-LENGTH IN PARSER: ',W_LEN
0034              ERR=.TRUE.
0035              RETURN
0036            ENDIF
0037            PTR=PTR+W_LEN*LEN+1 !THE FDM CODE WILL BE ACCESSED NEXT
0038            RETURN
0039            END
```

```
0001            SUBROUTINE PDB2POLY(FNAME)
0002      ************************************************************
0003      *       THIS SUBROUTINE TRANSFORMS THE RELATIVE DATA FROM  *
0004      *       THE DIGITIZER-PRODUCED PDB FILES INTO VERTICES OF  *
0005      *       POLYGONS IN UTM COORDINATES.                       *
0006      ************************************************************
0007      *       INPUTS: FNAME-- THE NAME OF THE INPUT FILE         *
0008      ************************************************************
0009            CHARACTER*5 FNAME
0010            LOGICAL ERR
0011            INCLUDE 'MAPDAT.CMN'
0012    1 ************************************************************
0013    1       REAL X,Y      !CURSOR POSITION
0014    1       REAL XCENTR,YCENTR !UTM CENTER OF MAP
0015    1       REAL XSCALE,YSCALE !METERS/TABLET UNIT
0016    1 ************************************************************
0017    1       COMMON/MAPDAT/X,Y,XCNTR,YCNTR,XSCALE,YSCALE
0018    1 ************************************************************
0019    1
0020    1
0021            INCLUDE 'WORDS.CMN'
0022    1 ************************************************************
0023    1       INTEGER*2 PTR          !POINTS TO CURRENT BYTE
0024    1       INTEGER*2 N_BYTES      !NUMBER OF BYTES IN FILE
0025    1       BYTE BYTES(11264)       !44 BLOCKS ON THE 4081
0026    1       INTEGER*2 WORDS(5632)!THE MAP COORDINATES ARE I*2
0027    1       EQUIVALENCE (WORDS(1),BYTES(1))
0028    1       COMMON/WORDS/BYTES,N_BYTES,PTR
0029    1 ************************************************************
0030    1
0031            INCLUDE 'FDM.PAR'
0032    1 ************************************************************
0033    1       INTEGER*2 FDM,L_R_M,L_R_D,S_R_M,S_R_D
0034    1       PARAMETER(
0035    1      +  HEADER=16,          !CODE FOR THE HEADER MODULE
0036    1      +  L_R_M= 28,          !LONG RELATIVE MOVE
0037    1      +  L_R_D= 29,          !LONG RELATIVE DRAW
0038    1      +  S_R_M= 32,          !SHORT RELATIVE MOVE
0039    1      +  S_R_D= 33)          !SHORT RELATIVE DRAW
0040    1 ************************************************************
0041            ERR=.FALSE.
0042      23    FORMAT(1X,A5)
0043            WRITE(6,23)FNAME
0044            CALL CALIBR8(FNAME,FDM,ERR)
0045             DO WHILE((PTR.LT.N_BYTES).AND.(.NOT.ERR))
0046               IF((FDM.EQ.S_R_M).OR.(FDM.EQ.L_R_M)) THEN
0047                 CALL MOVR(FDM,ERR)
0048               ELSE IF((FDM.EQ.S_R_D).OR.(FDM.EQ.L_R_D)) THEN
0049                 CALL DRAWR(FDM,ERR)
0050               ELSE
0051                 ERR=.TRUE.
0052                 WRITE(3,*)'IN FILE ',FNAME,' BAD FDM: ',FDM
0053                 RETURN
0054               ENDIF
0055             ENDDO
0056            RETURN
0057            END
```

```
0001              PROGRAM PDBREAD
0002     ************************************************************************
0003     *        THIS PACKAGE PROCESSES THE 4081-PRODUCED PDB FILES INTO *
0004     *        POLYGONS WHICH CAN BE DISPLAYED AND PACKED INTO SURFACE *
0005     *        FEATURE CODES IN THE TERRAIN DATA FILES BY THE ROUTINE  *
0006     *        PDBPACK.                                                *
0007     ************************************************************************
0008              LOGICAL EOF,ERR
0009              INCLUDE 'WORDS.CMN'
0010    1 ************************************************************
0011    1         INTEGER*2 PTR          !POINTS TO CURRENT BYTE
0012    1         INTEGER*2 N_BYTES      !NUMBER OF BYTES IN FILE
0013    1         BYTE BYTES(11264)       !44 BLOCKS ON THE 4081
0014    1         INTEGER*2 WORDS(5632)!THE MAP COORDINATES ARE I*2
0015    1         EQUIVALENCE (WORDS(1),BYTES(1))
0016    1         COMMON/WORDS/BYTES,N_BYTES,PTR
0017    1 ************************************************************
0018    1
0019              CHARACTER*9 NAMEIN,NAMEOUT
0020              DATA EOF/.FALSE./,ERR/.FALSE./
0021              CHARACTER*5 NAM
0022              EQUIVALENCE (NAMEIN,NAM)
0023              OPEN(UNIT=3,NAME='PDBERR.TXT',STATUS='NEW')
0024              OPEN(UNIT=7,NAME='PDB.TXT',STATUS='OLD')
0025              CALL SETGEO
0026              DO WHILE(.NOT.EOF)
0027                 CALL NAMEREAD(NAMEIN,EOF)
0028                 OPEN(UNIT=1,NAME=NAMEIN,TYPE='OLD',FORM='FORMATTED')
0029                 NAMEOUT=NAM//'.DAT'
0030                 OPEN(UNIT=2,NAME=NAMEOUT,TYPE='NEW',FORM='UNFORMATTED')
0031                 CALL FILEREAD(ERR)
0032                 WRITE(3,*)NAMEIN,N_BYTES
0033                 CALL PDB2POLY(NAM,ERR)
0034                 CLOSE(UNIT=1)
0035                 CLOSE(UNIT=2)
0036              ENDDO
0037              END
```

```
0001            SUBROUTINE POLYWRITE(POLY,P)
0002      ************************************************************
0003      *       THIS SCALES,TRANSLATES,AND WRITES THE DIGITIZED     *
0004      *       DATA WHICH HAS BEEN TRANSFORMED FROM RELATIVE       *
0005      *       TO ABSOLUTE FORM. AND WRITES THE DATA TO FILE 2     *
0006      ************************************************************
0007
0008            INTEGER*2 P                !# OF VERTICES
0009            DIMENSION POLY(1000,2)     !VERTICES OF A POLYGON
0010            REAL P1,P2
0011            INCLUDE 'CMERID.CMN'
0012    1 ******************************************************
0013    1       REAL*8 CMERID
0014    1       REAL P_RAD
0015    1       COMMON/CMERID/CMERID,P_RAD
0016    1 ******************************************************
0017            INCLUDE 'MAPDAT.CMN'
0018    1 ************************************************************
0019    1       REAL X,Y      !CURSOR POSITION
0020    1       REAL XCENTR,YCENTR !UTM CENTER OF MAP
0021    1       REAL XSCALE,YSCALE !METERS/TABLET UNIT
0022    1 ************************************************************
0023    1       COMMON/MAPDAT/X,Y,XCNTR,YCNTR,XSCALE,YSCALE
0024    1 ************************************************************
0025      C...  THE OLD SCALING INFO IS NOT WRITTEN
0026            IF(XSCALE.NE.1.)THEN
0027      C...  CONVERT THE ANGULAR MEASUREMENTS TO UTM
0028                P1=POLY(1,1)*P_RAD*XSCALE+XCNTR
0029                P2=POLY(1,2)*P_RAD*YSCALE+YCNTR
0030                CALL ADSMP(P2,P1,CMERID,FEAST,FNORTH)
0031                POLY(1,1)=FEAST+500000.
0032                POLY(1,2)=FNORTH
0033                NPTS=1
0034                DO 1=2,P
0035                  P1=POLY(I,1)*P_RAD*XSCALE+XCNTR
0036                  P2=POLY(I,2)*P_RAD*YSCALE+YCNTR
0037                  CALL ADSMP(P2,P1,CMERID,FEAST,FNORTH)
0038                  P1=FEAST+500000.
0039                  P2=FNORTH
0040      C...        IF THE POINTS ARE REASONABLY FAR APART...
0041                  IF(DELTA(POLY(NPTS,1),POLY(NPTS,2),P1,P2).GT.200.)THEN
0042                    NPTS=NPTS+1
0043                  POLY(NPTS,1)=P1
0044                  POLY(NPTS,2)=P2
0045                  ENDIF
0046                ENDDO
0047                IF(DELTA(POLY(NPTS,1),POLY(NPTS,2),POLY(1,1),POLY(1,2)).GT
0048                  NPTS=NPTS+1
0049                ENDIF
0050                POLY(NPTS,1)=POLY(1,1)
0051                POLY(NPTS,2)=POLY(1,2)
0052                WRITE(2)NPTS,((POLY(I,J),J=1,2),I=1,NPTS)
0053                NPTS=0
0054              ENDIF
0055              RETURN
0056              END
```

ROADHEXER CALLING SEQUENCE



*Terrain System Utilities

Figure B-15

PROGRAM: ROADHEXER

ROUTINE \ COMMON	CENTER	HEX	HEXRAD	LUKNOD	PACK	SUB
GETSUB				X		X
GRIDR						X
HEXINIT		X	X			
HEXSUB	X					X
HXRECORD					X	
LINKHEX				X	X	X
NOD2HX	X					
NODEHEX				X		X
PACKER				X		
ROADHEXER	X			X		

Figure B-16

```
0001            SUBROUTINE HEXSUB(HEXA,HEXB,N)
0002      ***************************************************
0003      *       BEGINNING AT HEXA, WHICH CONTAINS THE     *
0004      *       START NODE, A CHAIN OF ADJACENT HEXES     *
0005      *       IS GENERATED TO HEXB, WHICH CONTAINS      *
0006      *       THE STOP NODE FOR A LINK.                 *
0007      ***************************************************
0008      *       INPUTS:                                   *
0009      *              HEXA,HEXB-- THE HEXES WHICH        *
0010      *              CONTAIN THE TERMINAL NODES         *
0011      *              N-- THE NUMBER OF SUBNODES,        *
0012      *                NOT COUNTING THE ENDPOINTS.      *
0013      ***************************************************
0014            IMPLICIT INTEGER (H,P)
0015            INCLUDE"UTIL:SUB.CMN'
0016    1 ************************************************************
0017    1 *       SUBX,SUBY THE X AND Y COORDINATES OF THE SUBNODES  *
0018    1 *       IN ONE LINK (SEE BDM DOCUMENTATION)                *
0019    1 ************************************************************
0020    1       INTEGER*2 SUBX(100),SUBY(100)
0021    1       COMMON/SUB/ SUBX,SUBY
0022    1 ************************************************************
0023            INCLUDE 'UTIL:CENTER.CMN'
0024    1 ************************************************************
0025    1 *       THE CENTER OF THE HEX GRID IS AT XORIGIN,YORIGIN   *
0026    1 *       WHERE THE COORDINATES ARE IN METERS UTM RELATIVE   *
0027    1 *       TO A GIVEN GRID ZONE.                              *
0028    1 ************************************************************
0029    1       INTEGER*4 XORIGIN,YORIGIN
0030    1       COMMON/CENTER/XORIGIN,YORIGIN
0031    1       DATA XORIGIN/500000/,YORIGIN/5700000/
0032    1 ************************************************************
0033            LEV=4
0034      *
0035            HEXSTART=HEXA
0036            HEXSTOP=HEXB
0037      *
0038            I=0
0039            HEXC=-1  ! NOT A VALID HEX #
0040      *     PROCESS THE SUBNODE LIST UNTIL THE LINK   *
0041      *     ENTERS THE TERMINAL HEX                   *
0042            DO WHILE(HEXC.NE.HEXSTOP)
0043               I=I+1
0044               X=TRANX(SUBX(I))-XORIGIN
0045               Y=TRANY(SUBY(I))-YORIGIN
0046               CALL XYL2HA(X,Y,LEV,HEXC)
0047      *        IF THE SUBNODE IS NOT IN HEXA...          *
0048               IF(HEXSTART.NE.HEXC)THEN
0049                  CALL HXRECORD(HEXSTART,HEXC,IADJ)
0050      *           ...BUT IS IN AN ADJACENT HEX           *
0051                  IF(IADJ.EQ.1)THEN
0052      *              ...AND IS NOT IN HEXB               *
0053                     IF(HEXC.NE.HEXSTOP)THEN
0054                        CALL HXRECORD(HEXC,HEXSTOP,IADJ)
0055      *                 ...THEN IF IT IS ADJACENT TO HEXB...
0056                        IF(IADJ.EQ.1)THEN
0057      *                    DONE                         *
```

```
0058                              RETURN
0059                           ENDIF
0060     *                     OTHERWISE START OVER AT THIS SUBNODE
0061                           HEXSTART=HEXC
0062                        ENDIF
0063                     ENDIF
0064                  ENDIF
0065     *            GET THE NEXT SUBNODE
0066               ENDDO
0067               RETURN
0068               END
```

```
0001            SUBROUTINE HX-RECORD(HA,HB,IERR)
0002      ************************************************************
0003      *       THIS ROUTINE COMPUTES THE SIDE AT WHICH HEXA       *
0004      *       IS ADJACENT TO HEXB. IT PASSES THIS INFORMATION    *
0005      *       TO PACKER.  THEN IT INVERTS THE SIDE AND PASSES    *
0006      *       THE INVERTED SIDE ALONG WITH HEXB AND TYPE TO      *
0007      *       PACKER. THIS IS DONE TO INSURE THAT THE CONNEC-    *
0008      *       TIVITY LOOKS THE SAME FROM BOTH HEXES.  SINCE ONLY *
0009      *       OUTLINKS ARE CHECKED, SOMETHING OF THIS SORT IS    *
0010      *       NECESSARY.                                         *
0011      ************************************************************
0012      *         INPUT:  HA--THE HEX ADDRESS OF THE FIRST SUBNODE *
0013      *                 HB--THE HEX ADDRESS OF THE SECOND SUBNODE*
0014      *         OUTPUT: IERR-- AN ERROR FLAG                     *
0015      ************************************************************
0016            IMPLICIT INTEGER(H,P)
0017            INCLUDE 'UTIL:PACK.CMN'
0018    1 ************************************************************
0019    1       INTEGER*4 SIDES ! PACKED CONNECTIVITIES           *
0020    1       INTEGER*4 LTYPE ! CONNECTIVITY FOR CURRENT SIDE   *
0021    1       COMMON/PACK/SIDES,LTYPE
0022    1 ************************************************************
0023      *
0024      *       SUBTRACT BY ADDING THE INVERSE
0025      *       HSTORB IS THE INVERSE OF THE SIDE AT WHICH
0026      *       HEXB IS ADJACENT TO HEXA
0027      *       HSTORA AND HSTORB ARE IN INTERNAL HEX FORMAT
0028            HSTORB=HXADD(HA,HXINV(HB))
0029            HSTORA=HXINV(HSTORB)
0030      *
0031      *       GET THE RECORD FOR HEX 'HA' OR CAUSE IT TO
0032      *       BE INITIALIZED IF NECESSARY
0033            LU=7
0034            CALL HEXREAD(HA,SIDES,LU)
0035      *
0036      *       IERR IS A FLAG INDICATING THAT TWO ADJACENT
0037      *       SUBNODES WERE NOT IN ADJACENT HEXES
0038      *
0039            CALL PACKER(HA,HSTORA,IERR,LU)
0040            IF (IERR.EQ.0)RETURN
0041      *
0042      *       NOW FOR THE SECOND HEX
0043      *
0044      *       HSTORB IS THE SIDE OF HEXB AT WHICH HEXA
0045      *       IS ADJACENT
0046      *
0047            CALL HEXREAD(HB,SIDES,LU)
0048            CALL PACKER(HB,HSTORB,IERR,LU)
0049      *       THERE SHOULD BE NO ERROR IF IT GETS PAST
0050      *       THE FIRST CALL TO PACKER.
0051            RETURN
0052            END
```

```
0001            SUBROUTINE LINKHEX(LNKNUM,HEXA)
0002      ************************************************
0003      *       THIS ROUTINE CHECKS THE LINK TYPE FOR    *
0004      *       EACH LINK INCIDENT TO A NODE.  IF THE    *
0005      *       TYPE IS BETWEEN 1 AND 3 (ie; IF THE LINK *
0006      *       REPRESENTS A ROAD) THEN THE TERMINAL HEX *
0007      *       FOR THIS LINK IS OBTAINED FROM NOD2HX.   *
0008      *       IF THE LINK CONNECTS TWO HEXES THEN THE  *
0009      *       SUBNODES COORDINATES ARE READ IN AND EACH *
0010      *       PAIR OF ADJACENT SUBNODES(AND THE START  *
0011      *       AND STOP HEXES) ARE PROCESSED BY HXRECORD. *
0012      ************************************************
0013      *         INPUT:                                 *
0014      *               LNKNUM-- POINTER TO THE LINK RECORD *
0015      *               HEXA-- HEX CONTAINING THE NODE   *
0016      ************************************************
0017            IMPLICIT INTEGER (H,P)
0018            INTEGER*2 TMPLINK
0019            INTEGER*4 WRDPOS,SRECNUM,SUBWRD
0020      *     IF THE LINK CONNECTS TWO DIFFERENT HEXES,THEN
0021            INCLUDE 'UTIL:SUB.CMN'
0022    1 ****************************************************************
0023    1 *       SUBX,SUBY THE X AND Y COORDINATES OF THE SUBNODES IN   *
0024    1 *       ONE LINK (SEE BDM DOCUMENTATION)                       *
0025    1 ****************************************************************
0026    1       INTEGER*2 SUBX(100),SUBY(100)
0027    1       COMMON/SUB/ SUBX,SUBY
0028    1 ****************************************************************
0029            INCLUDE 'UTIL:PACK.CMN'
0030    1 ****************************************************************
0031    1       INTEGER*4 SIDES ! PACKED CONNECTIVITIES                  *
0032    1       INTEGER*4 LTYPE ! CONNECTIVITY FOR CURRENT SIDE          *
0033    1       COMMON/PACK/SIDES,LTYPE
0034    1 ****************************************************************
0035            INCLUDE 'UTIL:LNKNOD.CMN'
0036    1 ****************************************************************
0037    1 *       ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES         *
0038    1 ****************************************************************
0039    1       INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0040    1       COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0041    1      +  ,SUBREC(500)
0042    1 ****************************************************************
0043            NXTLNK=LNKNUM
0044            LU=3
0045            DO WHILE(NXTLNK.NE.0)
0046               CALL GETNDX(NXTLNK,LRECNUM,WRDPOS)
0047               CALL GETREC(LU,LRECNUM,LNKREC)
0048               N=WRDPOS
0049      *
0050      *        SET LINK TYPE                                        *
0051               TMPLINK=LIB$EXTZV(0,16,LNKREC(3,N))
0052               CALL LIB$INSV(TMPLINK,0,16,LTYPE)
0053      *
0054               IF(LTYPE.LT.4)THEN
0055                 LTYPE=4-LTYPE
0056                 TERMXY=LNKREC(4,WRDPOS)
0057                 CALL NOD2HX(TERMXY,HEXB)
```

```
0058                    IF(HEXA.NE.HEXB)THEN
0059                       CALL HXRECORD(HEXA,HEXB,IADJ)
0060                       IF(IADJ.EQ.0)THEN
0061     *
0062     *                    SET SUBNODE  RECORD POINTER                *
0063                          TMPLINK=LIB$EXTZV(0,16,LNKREC(5,N))
0064                          CALL LIB$INSV(TMPLINK,0,16,SRECNUM)
0065     *                    SET SUBNODE WORD POINTER                   *
0066                          TMPLINK=LIB$EXTZV(16,16,LNKREC(5,N))
0067     *                    CALL LIB$INSV(TMPLINK,0,16,SUBWRD)
0068     *                    GET THE SUBNODE LIST                       *
0069                          IF(SRECNUM.NE.0)THEN
0070                            CALL GETSUB(SRECNUM,SUBWRD,NUM)
0071     *                      PROCESS THE SUBNODE LIST
0072                            CALL HEXSUB(HEXA,HEXB,NUM)
0073                          ENDIF
0074                       ENDIF
0075                    ENDIF
0076                 ENDIF
0077     *           GET THE NEXT LINK RECORD
0078                 NXTLNK=LNKREC(2,WRDPOS)
0079              ENDDO
0080              RETURN
0081              END
```

```
0001            SUBROUTINE NOD2HX(XY,HSTOR)
0002      ************************************************
0003      *     THIS ROUTINE UNPACKS THE X AND Y COORD-   *
0004      *     INATES FROM A WORD OF THE LOC DATA BASE,  *
0005      *     (FROM THE NODE OR THE EMMENDED LINK FILE) *
0006      *     AND TRANSLATES IT TO A HEX ADDRESS.       *
0007      ************************************************
0008      *     INPUTS: XY-- THE PACKED COORDINATES       *
0009      *     OUTPUTS: HSTOR-- THE INTERNAL HEX NUMBER  *
0010      ************************************************
0011            IMPLICIT INTEGER(H,P)
0012            INTEGER*4 XY,TMPNOD
0013            INTEGER*2 X,Y
0014            INCLUDE 'UTIL:CENTER.CMN'
0015    1 ************************************************************
0016    1 *     THE CENTER OF THE HEX GRID IS AT XORIGIN,YORIGIN       *
0017    1 *     WHERE THE COORDINATES ARE IN METERS UTM RELATIVE       *
0018    1 *     TO A GIVEN GRID ZONE.                                  *
0019    1 ************************************************************
0020    1       INTEGER*4 XORIGIN,YORIGIN
0021    1       COMMON/CENTER/XORIGIN,YORIGIN
0022    1       DATA XORIGIN/500000/,YORIGIN/5700000/
0023    1 ************************************************************
0024      *
0025      *     SET X COORDINATE                                  *
0026            TMPNOD=LIBSEXTZV(0,16,XY)
0027            CALL LIBSINSV(TMPNOD,0,16,X)
0028            XX=TRANX(X)-XORIGIN
0029      *     SET Y COORDINATE
0030            TMPNOD=LIBSEXTZV(16,16,XY)
0031            CALL LIBSINSV(TMPNOD,0,16,Y)
0032            YY=TRANY(Y)-YORIGIN
0033      *
0034            LEV=4
0035            CALL XYL2HA(XX,YY,LEV,HSTOR)
0036            RETURN
0037            END
```

```
0001              SUBROUTINE NODEHEX(NODE)
0002        ************************************************
0003        *       THIS ROUTINE ACCESSES THE NODE RECORD    *
0004        *       FINDS THE HEX WHICH CONTAINS THE NODE,   *
0005        *       GETS THE LINK POINTER AND PASSES THIS    *
0006        *       POINTER AND THE HEX NUMBER TO LINKHEX    *
0007        ************************************************
0008        *       INPUT:  NODE-- THE HEAD NODE FOR A       *
0009        *                      GRID RECORD FROM THE      *
0010        *                      LOC DATA BASE             *
0011        ************************************************
0012              IMPLICIT INTEGER (H,P)
0013              INTEGER*4 WRDPOS
0014              INCLUDE 'UTIL:LNKNOD.CMN'
0015     1  ***************************************************************
0016     1  *       ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES       *
0017     1  ***************************************************************
0018     1        INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0019     1        COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0020     1       +  ,SUBREC(500)
0021     1  ***************************************************************
0022              INCLUDE 'UTIL:SUB.CMN'
0023     1  ************************************************************
0024     1  *       SUBX,SUBY THE X AND Y COORDINATES OF THE SUBNODES *
0025     1  *       IN ONE LINK (SEE BDM DOCUMENTATION)               *
0026     1  ************************************************************
0027     1        INTEGER*2 SUBX(100),SUBY(100)
0028     1        COMMON/SUB/ SUBX,SUBY
0029     1  ************************************************************
0030        C
0031              DO WHILE (NODE.NE.0)
0032                 CALL GETNDX(NODE,NRECNUM,WRDPOS)
0033                 LU=2
0034                 CALL GETREC(LU,NRECNUM,NODREC)
0035        C
0036                 NODXY=NODREC(5,WRDPOS)
0037                 CALL NOD2HX(NODXY,HEXA)
0038                 LNK=NODREC(4,WRDPOS)
0039                 CALL LINKHEX(LNK,HEXA)
0040        C
0041        *        GET NEXT NODE
0042                 NODE=NODREC(1,WRDPOS)
0043              ENDDO
0044              RETURN
0045              END
```

```
0001              PROGRAM ROADHEXER
0002        ************************************************
0003        *     THIS SET OF ROUTINES WAS USED TO 'HEXISE'  *
0004        *     THE BDM-PRODUCED LOC DATA FOR GERMANY.     *
0005        ************************************************
0006              IMPLICIT INTEGER(H,P)
0007              INTEGER*4 XO,YO
0008              INCLUDE 'UTIL:CENTER.CMN'
0009     1  ************************************************************
0010     1  *     THE CENTER OF THE HEX GRID IS AT XORIGIN,YORIGIN      *
0011     1  *     WHERE THE COORDINATES ARE IN METERS UTM RELATIVE      *
0012     1  *     TO A GIVEN GRID ZONE.                                *
0013     1  ************************************************************
0014     1        INTEGER*4 XORIGIN,YORIGIN
0015     1        COMMON/CENTER/XORIGIN,YORIGIN
0016     1        DATA XORIGIN/500000/,YORIGIN/5700000/
0017     1  ************************************************************
0018              INCLUDE 'UTIL:LNKNOD.CMN'
0019     1  ************************************************************
0020     1  *     ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES      *
0021     1  ************************************************************
0022     1        INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0023     1        COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0024     1       +  ,SUBREC(500)
0025     1  ************************************************************
0026        *
0027        *     INITIALIZE THE HEX PARAMETERS
0028        *     THE VARIABLES DLT AND DLN IN HEXINIT MUST
0029        *     AGREE WITH THE CENTER COORDINATES XORIGIN AND
0030        *     YORIGIN IN CENTER.CMN
0031              CALL HEXINIT
0032        *     OPEN THE LOC AND HEX FILES
0033              CALL OPENERS
0034        *     READ IN THE GRID POINTERS
0035              CALL GRIDR
0036        *     XO AND YO ARE THE RELATIVE COORDINATES
0037        *     OF THE CENTER OF THE AREA TO BE ACCESSED
0038        *     THAT IS, XO AND YO ARE OFFSETS IN METERS
0039        *     FROM THE CENTER OF THE HEX GRID.
0040              PRINT*,'ENTER THE COORDINATES OF THE CENTER OF THE '
0041              PRINT*,'AREA TO BE PROCESSED AS METERS FROM THE HEX ORIGIN'
0042              READ*,XO,YO
0043              XO=XORIGIN+XO
0044              YO=YORIGIN+YO
0045        *     SET THE GRID POINTERS FOR THE CENTER
0046              CALL IGRID(XO,YO,IO,JO)
0047              WRITE(6,*)'NOW ENTER THE LENGTH OF ONE SIDE OF THE SQUARE A
0048              READ(5,*)IEXT
0049              IEXT=IEXT/20 !DIVIDING BY 2 AND THEN BY 10 (1/2 SIDE,10KM R
0050              DO I=IO-IEXT,IO+IEXT,1
0051                 DO J=JO-IEXT,JO+IEXT,1
0052                    NODE=GRID(I,J)
0053                    CALL NODEHEX(NODE)
0054                 ENDDO
0055              ENDDO
0056              END
```

TERRAIN UTILITIES

```
0001            SUBROUTINE ADSCCM(IGRIDN,CMERID)
0002      C
0003      C         ***************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *       ADSCCM -- DETERMINE CENTRAL MERIDIAN OF A GRIDZONE
0007      C         *
0008      C         *  PURPOSE:
0009      C         *       TO CALCULATE THE CENTRAL MERIDIAN IN RADIANS OF
0010      C         *       A GRIDZONE USING THE INTEGER GRID NUMBER (E.G 32 OF '32
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *       AUTHOR - P. W. DENNIS
0014      C         *       LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0015      C         *       MOD LEVEL              DATE          DR NUMBERS
0016      C         *          01                  102979         DR 00009
0017      C         *
0018      C         *
0019      C         *  CALLING SEQUENCE:
0020      C         *       CALL ADSCCM (IGRIDN,CMERID)
0021      C         *       WHERE:
0022      C         *       ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C         *
0024      C         *       IGRIDN             GRID_NUMBER        INTEGER GRID NUMBER
0025      C         *
0026      C         *       CMERID             CENT_MERID         CENTRAL MERIDIAN
0027      C         *
0028      C         *                                             OF PROJECTION
0029      C         *
0030      C         *
0031      C         *  INPUT/OUTPUT:
0032      C         *
0033      C         *        NONE
0034      C         *
0035      C         *  RESTRICTIONS:
0036      C         *   NONE
0037      C         *
0038      C         ***************************************************************
0039      C
0040            REAL *8 CMERID
0041            PARAMETER PI=3.141592654
0042      C
0043      C     COMPUTE CENTRAL MERIDIAN
0044      C
0045            CMERID = DFLOTJ(IGRIDN*6-183)*PI/180.
0046      C
0047            RETURN
0048            END
```

```
0001            SUBROUTINE ADSCDD(FDEG,IDEG,IMIN,SEC)
0002      C
0003      C         ************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *      ADSCDD -- CONVERT DECIMAL DEGREES TO DEGREES-MINUTES-SE
0007      C         *
0008      C         *  PURPOSE:
0009      C         *      CONVERTS DEGREES TO INTEGER DEGREES AND MINUTES AND FLO
0010      C         *      POINT S            ECONDS
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *      AUTHOR - P. W. DENNIS
0014      C         *      LAST MODIFIED BY P. E. KING ON 28 OCT 79
0015      C         *      MOD LEVEL              DATE          DR NUMBERS
0016      C         *         01                 102979          DR 00009
0017      C         *
0018      C         *
0019      C         *  CALLING SEQUENCE:
0020      C         *      CALL ADSCDD (FDEG,IDEG,IMIN,SEC)
0021      C         *      WHERE:
0022      C         *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C         *
0024      C         *      FDEG               INP_DEGREES        F.P. DEGREES
0025      C         *
0026      C         *      IDEG               DEGREES            INTEGER DEGREES
0027      C         *
0028      C         *      IMIN               MINUTES            INTEGER MINUTES
0029      C         *
0030      C         *
0031      C         *      SEC                SECONDS            F.P. SECONDS
0032      C         *
0033      C         *
0034      C         *  INPUT/OUTPUT:
0035      C         *
0036      C         *       NONE
0037      C         *
0038      C         *  RESTRICTIONS:
0039      C         *   NONE
0040      C         *
0041      C         ************************************************************
0042      C
0043      C          COMPUTE DEGREES BY TAKING INTEGER PART
0044      C          DEGREES = INTEGER PART OF ABSOLUTE VALUE OF (INP_DEGREES)
0045      C
0046            IDEG =  ABS(FDEG)
0047      C
0048      C     GET MINUTES
0049      C     MINUTES = (ABSOLUTE VALUE OF (INP_DEGREES) MINUS DEGREES ) * 60
0050      C
0051            IMIN = (ABS(FDEG) - IDEG) * 60
0052      C
0053      C     GET SECONDS
0054      C     SECONDS = (ABSOLUTE VALUE OF (INP_DEGREES) MINUS DEGREES MINUS MINUT
0055      C                ES) * 3600
0056      C
0057            SEC = (ABS(FDEG) - IDEG - FLOAT(IMIN)/60.) * 3600.
```

```
0058      C
0059      C     TRUNCATE TO  .1 SECONDS
0060      C
0061            SEC = AINT(SEC*10.)/10.
0062      C
0063      C
0064            RETURN
0065            END
```

```
0001          SUBROUTINE ADSCFE(IGRIDN,IENUM)
0002     C
0003     C         ************************************************************
0004     C         *
0005     C         *  NAME:
0006     C         *       ADSCFE -- DETERMINE THE FIRST 100K SQUARE EAST
0007     C         *                 OF THE CENTRAL MERIDIAN
0008     C         *
0009     C         *  PURPOSE:
0010     C         *       TO DETERMINE A NUMBER CORRESPONDING TO THE
0011     C         *       FIRST 100K SQUARE EAST OF THE CENTRAL MERIDIAN
0012     C         *
0013     C         *  DESCRIPTION:
0014     C         *       AUTHOR - P. W. DENNIS
0015     C         *       LAST MODIFIED BY P. W. DENNIS ON 7 JAN 80
0016     C         *       ADD LEVEL              DATE          DR NUMBERS
0017     C         *          01                  102979         DR 00009
0018     C         *
0019     C         *
0020     C         *  CALLING SEQUENCE:
0021     C         *       CALL ADSCFE (IGRIDN,IENUM)
0022     C         *       WHERE:
0023     C         *       ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0024     C         *
0025     C         *       IGRIDN             INP_GRID_NUM       A GRID NUMBER
0026     C         *
0027     C         *       IENUM              EAST_100K_NUM      THE NUMBER CORRESPO
0028     C         *                                             TO THE FIRST EASTIN
0029     C         *                                             LETTER
0030     C         *
0031     C         *  INPUT/OUTPUT:
0032     C         *
0033     C         *       NONE
0034     C         *
0035     C         *  RESTRICTIONS:
0036     C         *   NONE
0037     C         *
0038     C         ************************************************************
0039     C
0040     C
0041     C     THE EASTING LETTER ID RANGES FROM 'A-Z' EXCLUDING LETTERS 'I' AND
0042     C     STARTING WITH 'A' AT EVERY THIRD GRIDZONE BEGINNING WITH GRIDZONE
0043     C     I.E. 1,4,7,...,58. SO FOR GRIDZONES 3,6,9,...,60, THE FIRST 100K
0044     C     SQUARE EAST OF THE CENTRAL MERIDIAN CAN BE REPRESENTED BY THE 21ST
0045     C     LETTER, 'V'; FOR GRIDZONES 1,4,7,...,58, THE FIRST 100K SQUARE EAS
0046     C     OF THE CENTRAL MERIDIAN CAN BE REPRESENTED BY THE 5TH LETTER, 'E',
0047     C     AND FOR GRIDZONES 2,5,8,...,59, THE FIRST 100K SQUARE EAST OF THE
0048     C     CENTRAL MERIDIAN CAN BE REPRESENTED BY THE 13TH LETTER, 'N'
0049     C
0050     C          ...FIND THE REMAINDER OF INP_GRID_NUM DIVIDED BY 3
0051     C
0052          II=MOD(IGRIDN,3)
0053     C
0054     C        CHECK FOR GRIDZONE NUMBERS THAT ARE MULTIPLES OF 3, I.E.,GRIDZO
0055     C        3,6,9,... ,60
0056     C
0057     C          IF THE REMAINDER EQUALS 0
```

```
0058     C
0059           IF (II.EQ.0) THEN
0060     C
0061     C          SET EAST_100K_NUM EQUAL TO 21 (EAST ID LETTER 'W')
0062     C
0063           IENUM = 21
0064     C
0065     C     CHECK FOR GRIDZONE NUMBERS INCREMENTED BY 3 STARTING WITH 1, I.E.,
0066     C     GRIDZONES 1,4,7,...,58
0067     C
0068     C          ELSEIF REMAINDER EQUALS 1
0069     C
0070           ELSEIF (II.EQ.1)THEN
0071     C
0072     C          SET EAST_100K_NUM EQUAL TO 5 (EAST ID LETTER 'E')
0073     C
0074           IENUM = 5
0075     C
0076     C     CHECK FOR GRIDZONE NUMBERS INCREMENTED BY 3 STARTING WITH 2, I.E.,
0077     C     GRIDZONES 2,5,8,...,59
0078     C
0079           ELSE
0080     C
0081     C          SET EAST_100K_NUM EQUAL TO 13 (EAST ID LETTER 'N')
0082     C
0083           IENUM = 13
0084     C
0085           ENDIF
0086           RETURN
0087           END
```

```
0001            SUBROUTINE ADSCGL(IGRIDL,IGLN,IERFLG)
0002      C
0003      C          ****************************************************************
0004      C          *
0005      C          *  NAME:
0006      C          *       ADSCGL -- PERFORM GRIDZONE LETTER TO NUMBER CONVERSION
0007      C          *
0008      C          *  PURPOSE:
0009      C          *       TO CONVERT THE GRIDZONE LETTER TO A  NUMBER FROM
0010      C          *       -10 TO 9 (0 THROUGH 9 NORTH OF EQUATOR)
0011      C          *
0012      C          *  DESCRIPTION:
0013      C          *       AUTHOR - P. W. DENNIS
0014      C          *       LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0015      C          *       MOD LEVEL              DATE          DR NUMBERS
0016      C          *          01                  102979         DR 00009
0017      C          *
0018      C          *
0019      C          *  CALLING SEQUENCE:
0020      C          *       CALL ADSCGL (IGRIDL,IGLN,IERFLG)
0021      C          *       WHERE:
0022      C          *       ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C          *
0024      C          *       IGRIDL             GRID_LETTER        THE GRIDZONE LETTER
0025      C          *
0026      C          *       IGLN               GRID_LETNUM        A NUMBER CORRESPOND
0027      C          *                                             TO GRID_LETTER
0028      C          *
0029      C          *       IERFLG             ERR_FLAG_UCS       ERROR FLAG (-1 = ER
0030      C          *
0031      C          *
0032      C          *  INPUT/OUTPUT:
0033      C          *
0034      C          *        NONE
0035      C          *
0036      C          *  RESTRICTIONS:
0037      C          *   NONE
0038      C          *
0039      C          ****************************************************************
0040      C
0041            PARAMETER ERROR = -1
0042      C
0043      C
0044            BYTE IGRIDL
0045      C
0046      C
0047      C          THE FIRST 10 LETTERS, 'C-M', REPRESENT GRIDZONES IN THE SOUTH
0048      C          HEMISPHERE. 'C' WILL BE REPRESENTED BY -10, 'D' BY -9,...,'M'
0049      C          THE LAST 10 LETTERS, 'N-X' REPRESENT GRIDZONES IN THE NORTHER
0050      C          HEMISPHERE. 'N' WILL BE REPRESENTED BY 0, 'P' BY 1, 'Q' BY 2,
0051      C          ,'X' BY 9. THESE NUMBERS WILL BE USED LATER FOR CALCULATING F
0052      C          NORTHING
0053      C
0054      C
0055      C
0056      C          GRID_LETTER GREATER THAN OR EQUAL TO 67 (ASCII 'C') ?
0057      C
```

```
0058            IF (IGRIDL.GE.67)  THEN
0059      C
0060      C               GRID_LETTER LESS THAN OR EQUAL TO 88 (ASCII 'X') ?
0061      C
0062            IF (IGRIDL.LE.88) THEN
0063      C
0064      C               GRID_LETTER LESS THAN 73 (ASCII 'I') ?
0065      C
0066            IF (IGRIDL.LT.73) THEN
0067      C
0068      C                    SET GRID_LETNUM TO GRID_LETTER MINUS 77
0069      C
0070            IGLN = IGRIDL - 77
0071      C
0072      C                    ELSE IS GRID_LETTER GREATER THAN 73 ?
0073      C
0074            ELSEIF (IGRIDL.GT.73) THEN
0075      C
0076      C                    GRID_LETTER LESS THAN 79 (ASCII 'O') ?
0077      C
0078            IF (IGRIDL.LT.79) THEN
0079      C
0080      C                    SET GRID_LETNUM TO GRID_LETTER MINUS 78
0081      C
0082            IGLN = IGRIDL - 78
0083      C
0084      C                    ELSEIF GRID_LETTER IS GREATER THAN 79
0085      C
0086            ELSEIF (IGRIDL.GT.79) THEN
0087      C
0088      C                    SET GRID_LETNUM TO GRID_LETTER MINUS 79
0089      C
0090            IGLN = IGRIDL - 79
0091      C
0092            ELSE
0093      C
0094      C                    SET ERR_FLAG_UCS
0095      C
0096            IERFLG = ERROR
0097      C
0098            ENDIF
0099            ELSE
0100      C
0101      C                    SET ERR_FLAG_UCS
0102      C
0103            IERFLG = ERROR
0104      C
0105            ENDIF
0106            ELSE
0107      C
0108      C                    SET ERR_FLAG_UCS
0109      C
0110            IERFLG = ERROR
0111      C
0112            ENDIF
0113            ELSE
0114      C
```

```
0115      C           SET ERR_FLAG_UCS
0116      C
0117                IERFLG = ERROR
0118      C
0119                ENDIF
0120                RETURN
0121                END
```

```
0001            SUBROUTINE ADSCIE(LEAST,IENUM,IEAST,IERFLG)
0002      C
0003      C         ***************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *      ADSCIE -- COMPUTE THE EASTING TO THE NEAREST 100 KILOME
0007      C         *
0008      C         *  PURPOSE:
0009      C         *      TO COMPUTE THE INTEGER EASTING FROM THE CENTRAL MERIDIA
0010      C         *      TO THE NEAREST 100 KILOMETERS
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *      AUTHOR - P. W. DENNIS
0014      C         *      LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0015      C         *      ADD LEVEL              DATE          DR NUMBERS
0016      C         *         01                  102979         DR 00009
0017      C         *
0018      C         *
0019      C         *  CALLING SEQUENCE:
0020      C         *      CALL ADSCIE (LEAST,IENUM,IEAST,IERFLG)
0021      C         *      WHERE:
0022      C         *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C         *
0024      C         *      LEAST              EAST_100K_LET      THE EASTING LETTER
0025      C         *                                            AN MGR
0026      C         *
0027      C         *      IENUM              EAST_100K_NUM      THE FIRST SQUARE EA
0028      C         *                                            THE CENTRAL MERIDIA
0029      C         *
0030      C         *      IEAST              EAST_INT           INTEGER EASTING IN
0031      C         *                                            100 KM UNITS
0032      C         *
0033      C         *      IERFLG             ERR_FLAG_UCS       ERROR FLAG (-1 = ER
0034      C         *
0035      C         *
0036      C         *  INPUT/OUTPUT:
0037      C         *
0038      C         *       NONE
0039      C         *
0040      C         *  RESTRICTIONS:
0041      C         *   NONE
0042      C         *
0043      C         ***************************************************************
0044      C
0045            PARAMETER ERROR = -1
0046      C
0047            BYTE LEAST
0048      C
0049            INTEGER *4 IEAST
0050      C
0051      C
0052      C       TO GET THE EASTING MEASURED FROM THE CENTRAL MERIDIAN, DETERMINE
0053      C       NUMBER CORRESPONDING TO THE EAST ID LETTER AND SUBTRACT THE
0054      C       NUMBER CORRESPONDING TO THE EAST ID LETTER OF THE FIRST 100K SQU
0055      C       EAST OF THE CENTRAL MERIDIAN. THEN MULTIPLY BY 100,000
0056      C
0057      C
```

```
0058     C            IF EAST_100K_LET IS GREATER THAN OR EQUAL TO 65 (ASCII 'A')
0059     C
0060              IF (LEAST.GE.65)THEN
0061     C
0062     C            IF EAST_100K_LET IS LESS THAN OR EQUAL TO 90 (ASCII 'Z')
0063     C
0064              IF (LEAST.LE.90)THEN
0065     C
0066     C            IF EAST_100K_LET IS LESS THAN 73 (ASCII 'I')
0067     C
0068              IF (LEAST.LE.73) THEN
0069     C
0070     C     SET EAST_INT TO ( EAST_100K_LET MINUS EAST_100K_NUM MINUS 54 ) * 10
0071     C
0072              IEAST = (LEAST - IENUM - 64) *100 000
0073     C
0074     C            ELSEIF EAST_100K_LET IS GREATER THAN 73
0075     C
0076              ELSEIF (LEAST.GT.73) THEN
0077     C
0078     C            IF EAST_100K_LET IS LESS THAN 79 (ASCII 'O')
0079     C
0080              IF (LEAST.LT.79) THEN
0081     C
0082     C     SET EAST_INT TO ( EAST_100K_LET MINUS EAST_100K_NUM MINUS 65 ) * 1
0083     C
0084              IEAST = (LEAST - IENUM - 65) *100 000
0085     C
0086     C            ELSEIF EAST_100K_LET IS GREATER THAN 79
0087     C
0088              ELSEIF (LEAST.GT.79) THEN
0089     C
0090     C     SET EAST_INT TO ( EAST_100K_LET MINUS EAST_100K_NUM MINUS 66 ) * 10
0091     C
0092              IEAST = (LEAST - IENUM - 66) *100 000
0093     C
0094     C            ELSE
0095     C
0096              ELSE
0097     C
0098     C            SET ERR_FLAG_UCS
0099     C
0100              IERFLG = ERROR
0101     C
0102     C            ENDIF
0103     C
0104              ENDIF
0105     C
0106     C            ELSE
0107     C
0108              ELSE
0109     C
0110     C            SET ERR_FLAG_UCS
0111     C
0112              IERFLG = ERROR
0113     C
0114     C            ENDIF
```

```
0115     C
0116           ENDIF
0117     C
0118     C           ELSE
0119     C
0120           ELSE
0121     C
0122     C           SET ERR_FLAG_UCS
0123     C
0124           IERFLG = ERROR
0125     C
0126     C           ENDIF
0127     C
0128           ENDIF
0129     C
0130     C           ELSE
0131     C
0132           ELSE
0133     C
0134     C           SET ERR_FLAG_UCS
0135     C
0136           IERFLG = ERROR
0137     C
0138     C           ENDIF
0139     C
0140           ENDIF
0141     C
0142     C       CHECK FOR EASTING BLATANTLY OUT OF RANGE
0143     C       (NO EASTING LETTER SHOULD BE MORE THAN 300 KM FROM
0144     C         THE CENTRAL MERIDIAN )
0145     C
0146           IF (IERFLG.NE.ERROR) THEN
0147           IF (IEAST.GT.300 000 .OR. IEAST.LT.-300 000) THEN
0148           IERFLG=ERROR
0149           ENDIF
0150           ENDIF
0151           RETURN
0152           END
```

```
0001            SUBROUTINE ADSCIN(IGLN,IGRIDN,N100KN,NORTH,ISPHER)
0002      C
0003      C         ***************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *      ADSCIN -- COMPUTE THE NORTHING TO THE NEAREST 100
0007      C         *     KILOMETERS
0008      C         *  PURPOSE:
0009      C         *      TO COMPUTE THE INTEGER NORTHING FROM THE EQUATOR
0010      C         *      TO THE NEAREST 100 KILOMETERS
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *      AUTHOR - P. W. DENNIS
0014      C         *      LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0015      C         *      MOD LEVEL              DATE          DR NUMBERS
0016      C         *         01                 102979          DR 00009
0017      C         *
0018      C         *
0019      C         *  CALLING SEQUENCE:
0020      C         *      CALL ADSCIN (IGLN,IGRIDN,N100KN,NORTH,ISPHER)
0021      C         *      WHERE:
0022      C         *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C         *
0024      C         *      IGLN               GRID_LETNUM        NUMBER CORRESPONDIN
0025      C         *                                            THE GRIDZONE LETTER
0026      C         *
0027      C         *      IGRIDN             INP_GRID_NUM       THE NUMBER OF THE
0028      C         *                                            GRIDZONE
0029      C         *      N100KN             NORTH_100K_NUM     THE NUMBER CORRESPO
0030      C         *                                            100K SQUARE NORTHIN
0031      C         *                                            LETTER
0032      C         *
0033      C         *      NORTH              NORTH_INT          INTEGER NORTHING IN
0034      C         *                                            100 KM UNITS
0035      C         *      ISPHER             INP_SPHEROID       SPHEROID INDEX
0036      C         *
0037      C         *
0038      C         *  INPUT/OUTPUT:
0039      C         *
0040      C         *       NONE
0041      C         *
0042      C         *  RESTRICTIONS:
0043      C         *
0044      C         *      (1) THE REFERENCE GRIDZONE IS IN THE SHARED GLOBAL AREA
0045      C         *      (2) THE MGR INDEXED SPHEROID TABLE IS IN THE
0046      C         *          SHARED GLOBAL AREA.
0047      C         *
0048      C         *
0049      C         ***************************************************************
0050      C
0051      C
0052            INCLUDE 'ZDBPRO.COM'
00100   0053  1 C
00200   0054  1 C       DUMMY COMMON ZDBPRO
00300   0055  1 C
00400   0056  1         INTEGER*4 ZRFDAY,ZIDCNT,ZYDOG,ZTSEC(4),ZTEX(5)
00500   0057  1         INTEGER*2 ZSPHID,ZYGOAT,ZTSN,ZRGN,ZRGL,ZMGRST(3,3),ZLLST(5
```

```
00600    0058  1        LOGICAL*1 ZISIC(3),ZIDWN(25)
00700    0059  1 C
00800    0060  1        COMMON /ZDBPRO/ ZRFDAY,ZIDCNT,ZYDOG,ZITSEC,ZIEX,
00900    0061  1       2                ZSPHID,ZYGOAT,ZITSN ,ZRGN ,ZISIC,
01000    0062  1       3                ZIDWN ,ZRGL  ,ZMGRST,ZLLST
01100    0063  1 C
         0064    C
         0065            PARAMETER PI = 3.141593
         0066    C
         0067    C
         0068    C
         0069    C
         0070            INTEGER *4 NDIST
         0071            INTEGER *4 NORTH
         0072            INCLUDE 'ADSTAB.DAT'
         0073  1 C       ************************************************************
         0074  1 C
         0075  1 C          TABLE OF SPHEROID AXES
         0076  1 C
         0077  1 C       ************************************************************
         0078  1 C
         0079  1         DIMENSION AAXIS(9),BAXIS(9)
         0080  1 C
         0081  1 C                              THE SEMI-MAJOR AXES
         0082  1 C
         0083  1         DATA  AAXIS            /
         0084  1        1                         6378388.,      !    INTERNATIONAL
         0085  1        2                         6378206.,      !    CLARKE 1866
         0086  1        3                         6378249.,      !    CLARKE 1880
         0087  1        4                         6377276.,      !    EVEREST
         0088  1        5                         6377397.,      !    BESSEL
         0089  1        6                         6378160.,      !    AUSTRALIAN NATI
         0090  1        7                         6377397.,      !    AIRY
         0091  1        8                         6378155.,      !    FISCHER
         0092  1        9                         6377304. /     !    MALAYAN
         0093  1 C
         0094  1 C                              THE SEMI-MINOR AXES
         0095  1 C
         0096  1         DATA  BAXIS            /
         0097  1        1                         6356912.,      !    INTERNATIONAL
         0098  1        2                         6356584.,      !    CLARKE 1866
         0099  1        3                         6356515.,      !    CLARKE 1880
         0100  1        4                         6356075.,      !    EVEREST
         0101  1        5                         6356079.,      !    BESSEL
         0102  1        6                         6356775.,      !    AUSTRALIAN NATI
         0103  1        7                         6356257.,      !    AIRY
         0104  1        8                         6356774.,      !    FISCHER
         0105  1        9                         6356102. /     !    MALAYAN
         0106  1 C
         0107  1 C
         0108  1 C              MOD LEVEL              DATE                    DR NUMBE
         0109  1 C                01                 110979                   DR 0000
         0110  1 C
         0111  1 C
         0112  1 C          LAST MODIFIED BY P. E. KING ON 9 NOVEMBER 79
         0113  1 C
         0114  1 C
```

```
0115  1 C    ***************************************************************
0116  1 C      *************************************************************
0117    C
0118    C
0119    C              COMPUTE APPROXIMATE DISTANCE USING GRID_LETNUM
0120    C
0121    C           NORTH_DIST = SEMI_MAJ*(GRID_LETNUM * 8 + 4) * PI_CONS
0122    C
0123              NDIST = AAXIS(ZSPHID)*(FLOAT(IGLN)*8. + 4.)*PI/180.
0124    C
0125    C                 CALCULATE TO THE NEAREST 2000 KILOMETERS
0126    C
0127    C        NORTH_INT = 2,000,000 * INTEGER PART OF (NORTH_DIST DIVIDED
0128    C
0129              NORTH = 2 000 000 * (NDIST /2 000 000)
0130    C
0131    C                 ADD ON 100 KILOMETER PART
0132    C
0133    C           NORTH_INT = NORTH_INT + 100,000 * NORTH_100K_NUM
0134    C
0135              NORTH = NORTH + 100 000 * N100KN
0136    C
0137    C                 CHECK FOR TOO FAR NORTH
0138    C
0139    C           IF NORTH_INT - NORTH_DIST IS GREATER THAN 1,500,000
0140    C
0141              IF (NORTH - NDIST .GT. 1 500 000)  THEN
0142    C
0143    C           SET NORTH_INT TO NORTH_INT MINUS 2,000,000
0144    C
0145              NORTH = NORTH - 2 000 000
0146    C
0147    C                 OR TOO FAR SOUTH
0148    C
0149    C           ELSEIF NORTH_DIST - NORTH_INT IS GREATER THAN 1,500,0
0150    C
0151              ELSEIF (NDIST - NORTH .GT. 1 500 000)  THEN
0152    C
0153    C           SET NORTH_INT TO NORTH_INT PLUS 2,000,000
0154    C
0155              NORTH = NORTH + 2 000 000
0156    C
0157    C
0158              ENDIF
0159    C
0160    C            NOW CHECK FOR THE 1000 KILOMETER JUMP ACROSS SPHEROI
0161    C
0162    C           IF ABSOLUTE VALUE OF (NORTH_INT - NORTH_DIST) IS GREA
0163    C
0164    C                          GET INDEX TO MGR INDEXED SPHEROID TABLE
0165    C
0166              IROW = 'IGRION - ZRGN + 2
0167    C
0168    C
0169    C         WATCH OUT FOR  ZONES 1 AND 60
0170    C
0171              IF (IROW.EQ. -57 .OR. IROW .EQ. 61)  THEN
```

```
0172            IROW = 1
0173            ENDIF
0174      C
0175            IF (IABS (NDIST - NORTH).GT. 500 000)  THEN
0176      C
0177      C           IF NORTH_INT IS GREATER THAN NORTH_DIST
0178      C
0179            IF (NORTH .GT. NDIST)  THEN
0180      C
0181      C           SET NORTH_INT TO NORTH_INT MINUS 1,000,000
0182      C
0183            NORTH = NORTH - 1 000 000
0184      C
0185      C
0186            ELSE
0187      C
0188      C           SET NORTH_INT TO NORTH_INT PLUS 1,000,000
0189      C
0190            NORTH = NORTH + 1 000 000
0191      C
0192      C
0193            ENDIF
0194      C
0195      C     SET INP_SPHEROID TO HIGH BYTE OF MGR_SPHEROID_TAB
0196      C
0197            ISPHER = ZMGRST(IROW,IGLN - ZRGL + 2)/256
0198      C
0199      C
0200            ELSE
0201      C
0202      C     SET INP_SPHEROID TO LOW BYTE OF MGR_SPHEROID_TAB
0203      C
0204            ISPHER = MOD (ZMGRST(IROW,IGLN - ZRGL + 2), 256)
0205      C
0206            ENDIF
0207      C
0208            RETURN
0209            END
```

```
0001            SUBROUTINE ADSCLN(LAT,LONG,NORTH,IEAST,IERFLG)
0002      C
0003      C         ***************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *       ADSCLN  -- LATLONG TO EASTING-NORTHING CONVERSION
0007      C         *
0008      C         *  PURPOSE:
0009      C         *       TO CONVERT ASCII LATITUDE AND LONGITUDE TO
0010      C         *        EASTINGS AND NORTHINGS.
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *       AUTHOR - P. W. DENNIS
0014      C         *       LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0015      C         *       MOD LEVEL              DATE          DR NUMBERS
0016      C         *          01                  102979         DR 00009
0017      C         *
0018      C         *
0019      C         *  CALLING SEQUENCE:
0020      C         *       CALL ADSCLN (LAT,LONG,NORTH,IEAST,IERFLG)
0021      C         *       WHERE:
0022      C         *       ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C         *
0024      C         *       IEAST              EAST_LCS           UTM EASTING
0025      C         *
0026      C         *       NORTH             NORTH_LCS          UTM NORTHING
0027      C         *
0028      C         *       IERFLG             ERR_FLAG_LCS       ERROR FLAG (-1 = EH
0029      C         *
0030      C         *
0031      C         *       LAT                LAT_LCS            LATITUDE (ASCII)
0032      C         *
0033      C         *       LONG               LONG_LCS           LONGITUDE (ASCII)
0034      C         *
0035      C         *  INPUT/OUTPUT:
0036      C         *
0037      C         *        NONE
0038      C         *
0039      C         *  RESTRICTIONS:
0040      C         *
0041      C         *    (1) THE REFERENCE GRIDZONE IS IN  THE SGA COMMON
0042      C         *    (2) THE REFERENCE SPHEROID IS IN THE SGA COMMON
0043      C         *
0044      C         ***************************************************************
0045      C
0046            PARAMETER PI = 3.141592654
0047      C
0048            PARAMETER OK=0
0049            PARAMETER ERROR = -1
0050      C
0051      C
0052            INCLUDE 'ZDBPRO.COM'
00100     0053  1 C
00200     0054  1 C       DUMMY COMMON ZDBPRO
00300     0055  1 C
00400     0056  1         INTEGER*4 ZRFDAY,ZIDCNT,ZYDOG,ZTSEC(4),ZTEX(5)
00500     0057  1         INTEGER*2 ZSPHID,ZYGOAT,ZTSN,ZRGN,ZRGL,ZMGRST(3,3),ZLLST(5
```

```
00600    0058  1        LOGICAL*1 ZISIC(3),ZIDWN(25)
00700    0059  1 C
00800    0060  1        COMMON /ZDBPRO/ ZRFDAY,ZIDCNT,ZYDOG,ZISEC,ZIEX,
00900    0061  1       2                ZSPHID,ZYGOAT,ZISN ,ZRGN ,ZISIC,
01000    0062  1       3                ZIDWN ,ZRGL  ,ZMGRSI,ZLLSI
01100    0063  1 C
         0064           BYTE LAT(2),LONG(2),IHEMIS
         0065           REAL*8 FLAT,FLONG,CMERID
         0066     C
         0067           INTEGER *4 NORTH,IEAST
         0068     C
         0069           INTEGER *2 IDEG,MIN
         0070     C
         0071     C          INITIALIZE ERR_FLAG_LCS TO 'OK' (=0)
         0072     C
         0073           IERFLG=OK
         0074     C
         0075     C          ...CONVERT ASCII LAT/LONG TO FLOATING POINT RADIANS
         0076     C
         0077     C
         0078     C          ...FIRST THE LATITUDE
         0079     C
         0080     C
         0081     C          ...DECODE LAT_LCS INTO THE VARIABLES DEGREES,MINUTES,
         0082     C          ...AND HEMISPHERE
         0083     C          DECODE CHARACTER DATA ACCORDING TO FORMAT SPECIFICATI
         0084     C
         0085  C  D        WRITE (5,1) LAT,LONG
         0086  C  D1       FORMAT (' LAT= ',9A1,' LONG= ',10A1)
         0087           DECODE (9,1001,LAT,ERR=9999) IDEG,MIN,SEC,IHEMIS
         0088      1001 FORMAT (2I2,F4.1,A1)
         0089     C
         0090     C       CHECK FOR VALID LIMITS OF LATITUDE
         0091     C
         0092           IF(IDEG.LT.90 .AND. MIN.LT.60 .AND. SEC.LT.60.)  THEN
         0093     C
         0094     C       CONVERT TO RADIANS
         0095     C
         0096           FLAT = (DFLOTI(IDEG) + DFLOTI(MIN)/60. + DBLE(SEC)/3600.)
         0097     C
         0098     C          IF HEMISPHERE IS 'S' CHANGE SIGN
         0099     C
         0100               IF (IHEMIS.EQ.'S')  THEN
         0101     C
         0102     C          SET LAT_COORD TO NEGATIVE LAT_COORD
         0103     C
         0104               FLAT = -FLAT
         0105     C
         0106     C          ELSEIF HEMISPHERE IS NOT 'N' SET ERROR FLAG
         0107     C
         0108               ELSEIF (IHEMIS.NE.'N')  THEN
         0109  C  D        WRITE (5,2)
         0110  C  D2       FORMAT (' ERROR--HEMISPHERE IS NOT NORTH')
         0111               IERFLG = ERROR
         0112               RETURN
         0113               ENDIF
         0114           ELSE
```

```
0115 C  D      WRITE (5,3)
0116 C  D3     FORMAT (' DEG IS GT 90 OR MIN IS GT 60 OR SEC IS GT 60.')
0117           IERFLG = ERROR
0118           RETURN
0119           ENDIF
0120      C
0121      C          ...NOW DO LONGITUDE
0122      C
0123      C          ...DECODE LONG_LCS INTO THE VARIABLES DEGREES,MINUTES
0124      C          ...AND HEMISPHERE
0125      C
0126      C          DECODE CHARACTER DATA ACCORDING TO FORMAT SPECIFICATI
0127      C
0128           DECODE(10,1002,LONG,ERR=9999) IDEG,MIN,SEC,IHEMIS
0129       1002 FORMAT (I3,I2,F4.1,A1)
0130      C
0131      C       CHECK FOR VALID LONGITUDE LIMITS
0132      C
0133           IF (IDEG.LE.180 .AND. MIN.LT.60 .AND. SEC.LT.60.)  THEN
0134      C
0135      C       CONVERT TO RADIANS
0136      C
0137           FLONG = (DFLOTI(IDEG)+DFLOTI(MIN)/60.+ DBLE(SEC)/3600.)*PI
0138      C
0139      C          IF HEMISPHERE IS 'W' CHANGE SIGN OF LONG
0140      C
0141                IF (IHEMIS.EQ.'W')  THEN
0142      C
0143      C          SET LONG_COORD TO NEGATIVE LONG_COORD
0144      C
0145                FLONG = -FLONG
0146      C
0147      C          ELSEIF HEMISPHERE IS NOT 'E' SET ERROR FLAG
0148      C
0149                ELSEIF (IHEMIS.NE.'E')  THEN
0150 C  D            WRITE (5,4)
0151 C  D4           FORMAT (' HEMISPHERE IS NOT WEST')
0152      C
0153                IERFLG = ERROR
0154                RETURN
0155                ENDIF
0156           ELSE
0157 C  D      WRITE (5,5)
0158 C  D5     FORMAT (' DEG IS GT 180 OR MIN IS GT 60 OR SEC IS GT 60.')
0159           IERFLG = ERROR
0160           RETURN
0161           ENDIF
0162      C
0163      C          ...HAVE LAT/LONG IN RADIANS, NOW PROJECT INTO CYLINDE
0164      C
0165      C
0166      C          DETERMINE THE CENTRAL MERIDIAN OF A GRIDZONE(REF_GRID_
0167      C
0168           CALL ADSCCM(ZONE,CM_GRID)
0169      C
0170      C          SET SPHEROID PARAMETERS(REF_SPHEROID)
0171      C
```

```
0172            CALL ADSSSP(ZSPHID)
0173      C
0174      C           PERFORM UTM PROJECTION
0175      C
0176            CALL ADSMP(FLAT,FLONG,CMERID,FEAST,FNORTH)
0177      C
0178            IEAST = FEAST
0179            NORTH = FNORTH
0180      C
0181            RETURN
0182      C
0183      C     ERROR EXIT FOR DECODE
0184      C
0185       9999 IERFLG = ERROR
0186  C   D      WRITE (5,6)
0187  C   D5     FORMAT (' DECODE ERROR')
0188            RETURN
0189            END
```

```
0001            SUBROUTINE ADSCNI(IGLN,IGRIDN,LNORTH,N100KN,IERFLG)
0002      C
0003      C         ****************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *      ADSCNI -- PERFORM 100K NORTHING ID LETTER TO INTEGER
0007      C         *                NORTHING CONVERSION
0008      C         *
0009      C         *  PURPOSE:
0010      C         *      TO CONVERT THE 100K NORTHING ID LETTER TO A
0011      C         *      NUMBER WHICH CORRESPONDS TO THE NUMBER OF 100K SQUARES
0012      C         *      FROM THE EQUATOR (MODULO 20)
0013      C         *
0014      C         *  DESCRIPTION:
0015      C         *      AUTHOR - P. M. DENNIS
0016      C         *      LAST MODIFIED BY P. M. DENNIS ON 08 JAN 80
0017      C         *      MOD LEVEL              DATE          DR NUMBERS
0018      C         *         01                 102979          DR 00009
0019      C         *
0020      C         *
0021      C         *  CALLING SEQUENCE:
0022      C         *      CALL ADSCNI (IGLN,IGRIDN,LNORTH,N100KN,IERFLG)
0023      C         *      WHERE:
0024      C         *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0025      C         *
0026      C         *      IGRIDL             GRID_LETTER     THE GRIDZONE LETTER
0027      C         *
0028      C         *      IGLN               GRID_LETNUM        A NUMBER CORRESPOND
0029      C         *                                            TO GRID_LETTER
0030      C         *
0031      C         *      IERFLG             ERR_FLAG_UCS       ERROR FLAG (-1 = ER
0032      C         *
0033      C         *
0034      C         *  INPUT/OUTPUT:
0035      C         *
0036      C         *       NONE
0037      C         *
0038      C         *  RESTRICTIONS:
0039      C         *   NONE
0040      C         *
0041      C         ****************************************************************
0042      C
0043      C
0044            PARAMETER OK =0
0045            PARAMETER ERROR = -1
0046      C
0047            BYTE LNORTH
0048      C
0049      C      NORTHING LETTER IDS GO FROM 'A-V' (NO 'I' OR 'O') AND START OVER
0050      C      EVERY 2,000,000 METERS (20 SQUARES). IN THE NORTHERN HEMISPHERE
0051      C      STARTING AT THE EQUATOR, LETTERS START WITH 'A' FOR THE ODD GRID
0052      C      NUMBERS AND WITH 'F' FOR THE EVEN GRID NUMBERS. SO, FOR ODD GRID
0053      C      NUMBERS, 'A' IS REPRESENTED BY 0, 'B' BY 1, 'C' BY 2,..., 'V' BY
0054      C      AND FOR EVEN GRID NUMBERS, 'F' IS REPRESENTED BY 0, 'G' BY 1, 'H'
0055      C      2,..., 'V' BY 14, 'A' BY 15,..., 'E' BY 19.
0056      C      IN THE SOUTHERN HEMISPHERE STARTING AT THE EQUATOR, LETTER START
0057      C      FROM V AND GO BACKWARDS FOR ODD GRID NUMBERS, AND FROM E AND GO
```

```
0058     C       BACKWARDS FOR EVEN GRID NUMBERS. SO, FOR ODD GRID NUMBERS, 'V' IS
0059     C       REPRESENTED BY -1, 'U' BY -2, 'T' BY -3,..., 'A' BY -19, AND FOR
0060     C       EVEN GRID NUMBERS, 'E' IS REPRESENTED BY -1, 'D' BY -2,..., 'A' B
0061     C       'V' BY -o,..., 'F' BY -19
0062     C
0063     C
0064     C
0065     C
0066     C            IF NORTH_100K_LET IS GREATER OR EQUAL TO 65 (ASCII 'A')
0067     C
0068              IF (LNORTH.GE.65) THEN
0069     C
0070     C            IF NORTH_100K_LET IS LESS THAN OR EQUAL TO 8o (ASCII 'V')
0071     C
0072              IF (LNORTH.LE.8o) THEN
0073     C
0074     C            IF NORTH_100K_LET IS LESS THAN 73 (ASCII 'I')
0075     C
0076              IF (LNORTH.LT.73) THEN
0077     C
0078     C            SET NORTH_100K_NUM TO NORTH_100K_LET MINUS 65
0079     C
0080              N100KN = LNORTH - 65
0081     C
0082     C            ELSE IF NORTH_100K_LET IS GREATER THAN 73
0083     C
0084              ELSE IF (LNORTH.GT.73) THEN
0085     C
0086     C            IF NORTH_100K_LET IS LESS THAN 79 (ASCII 'O')
0087     C
0088              IF (LNORTH.LT.79) THEN
0089     C
0090     C            SET NORTH_100K_NUM TO NORTH_100K_LET MINUS 66
0091     C
0092              N100KN = LNORTH - 66
0093     C
0094     C            ELSE IF NORTH_100K_LET IS GREATER THAN 79
0095     C
0096              ELSE IF (LNORTH.GT.79) THEN
0097     C
0098     C            SET NORTH_100K_NUM TO NORTH_100K_LET MINUS 67
0099     C
0100              N100KN = LNORTH - 67
0101     C
0102              ELSE
0103     C
0104     C            SET ERR_FLAG_UCS TO -1
0105     C
0106              IERFLG = ERROR
0107     C
0108     C            END IF
0109              END IF
0110     C
0111     C
0112              ELSE
0113     C
0114     C            SET ERR_FLAG_UCS TO -1
```

```
0115     C
0116             IERFLG = ERROR
0117     C
0118     C           END IF
0119             END IF
0120     C
0121             ELSE
0122     C
0123     C           SET ERR_FLAG_UCS TO -1
0124     C
0125             IERFLG = -1
0126     C
0127             END IF
0128     C
0129             ELSE
0130     C
0131     C           SET ERR_FLAG_UCS TO -1
0132     C
0133             IERFLG = ERROR
0134     C
0135             END IF
0136     C           IF ERR_FLAG_UCS IS 'OK' (=0)
0137     C
0138             IF (IERFLG.EQ.OK) THEN
0139     C
0140     C           IF INP_GRID_NUM IS EVEN
0141     C
0142             IF (MOD(IGRIDN,2).EQ.0) THEN
0143     C
0144     C           SET NORTH_100K_NUM TO NORTH_100K_NUM MINUS 5
0145     C
0146             N100KN = N100KN - 5
0147     C
0148     C           IF NORTH_100K_NUM IS LESS THAN ZERO
0149     C
0150             IF (N100KN.LT.0) THEN
0151     C
0152     C           SET NORTH_100K_NUM TO NORTH_100K_NUM PLUS 20
0153     C
0154             N100KN = N100KN + 20
0155     C
0156     C
0157             END IF
0158     C
0159             END IF
0160     C
0161     C           IF GRID_LETNUM IS LESS THAN ZERO
0162     C
0163             IF (IGLN.LT.0) THEN
0164     C
0165     C           SET NORTH_100K_NUM TO NORTH_100K_NUM MINUS 20
0166     C
0167             N100KN = N100KN - 20
0168     C
0169             END IF
0170     C
0171             END IF
```

```
0172            RETURN
0173            END
```

```
0001                SUBROUTINE ADSCNL(NORTH,IEAST,LAT,LONG,IERFLG)
0002      C
0003      C           ***************************************************************
0004      C           *
0005      C           *  NAME:
0006      C           *      ADSCNL -- EASTING-NORTHING TO LATLONG CONVERSION
0007      C           *
0008      C           *  PURPOSE:
0009      C           *      TO CONVERT EASTING NORTHING TO
0010      C           *      ASCII LATITUDE AND LONGITUDE
0011      C           *
0012      C           *  DESCRIPTION:
0013      C           *      AUTHOR - P. W. DENNIS
0014      C           *      LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0015      C           *      MOD LEVEL              DATE          DR NUMBERS
0016      C           *         01                  102979         DR 00009
0017      C           *
0018      C           *
0019      C           *  CALLING SEQUENCE:
0020      C           *      CALL ADSCNL (NORTH,IEAST,LAT,LONG,IERFLG)
0021      C           *      WHERE:
0022      C           *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C           *
0024      C           *      IEAST              EAST_LCS           UTM EASTING
0025      C           *
0026      C           *       NORTH             NORTH_LCS          UTM NORTHING
0027      C           *
0028      C           *      IERFLG             ERR_FLAG_LCS       ERROR FLAG (-1 = ER
0029      C           *
0030      C           *
0031      C           *      LAT                LAT_LCS            LATITUDE (ASCII)
0032      C           *
0033      C           *      LONG               LONG_LCS           LONGITUDE (ASCII)
0034      C           *
0035      C           *  INPUT/OUTPUT:
0036      C           *
0037      C           *       NONE
0038      C           *
0039      C           *  RESTRICTIONS:
0040      C           *
0041      C           *      (1) THE REFERENCE GRIDZONE IS IN THE SGA COMMON
0042      C           *      (2) THE REFERENCE SPHEROID IS IN THE SGA COMMON
0043      C           *
0044      C           *
0045      C           ***************************************************************
0046      C
-0047               PARAMETER PI = 3.141592654
0048      C
0049      C
0050      C
0051                INCLUDE 'ZDBPRO.COM'
00100     0052    1 C
00200     0053    1 C       DUMMY COMMON ZDBPRO
00300     0054    1 C
00400     0055    1         INTEGER*4 ZREDAY,ZIDCNT,ZYDOG,ZTSEC(4),ZTEX(5)
00500     0056    1         INTEGER*2 ZSPHID,ZYGOAT,ZTSN,ZRGN,ZRGL,ZMGRST(3,3),ZLLST(5
00600     0057    1         LOGICAL*1 ZTSIC(3),ZTDWN(25)
```

```
00700    0058  1 C
00800    0059  1       COMMON /ZDBPRO/ ZRFDAY,ZIDCNT,ZYDOG,ZTSEC,ZTEX,
00900    0060  1      2                ZSPHID,ZYGOAT,ZTSN ,ZRGN ,ZTSIC,
01000    0061  1      3                ZTDWN ,ZRGL  ,ZMGRST,ZLLST
01100    0062  1 C
         0063          BYTE LAT(1),LONG(1)
         0064          REAL*8 FLAT,FLONG,CM
         0065    C
         0066          INTEGER *4 NORTH,IEAST
         0067    C
         0068          FEAST = IEAST
         0069          FNORTH = NORTH
         0070    C
         0071    C          ...COMPUTE THE CENTRAL MERIDIAN OF THE REFERENCE GRIDZ
         0072    C          DETERMINE THE CENTRAL MERIDIAN OF A GRIDZONE(REF_GRID_
         0073    C
         0074          CALL ADSCCM(ZRGN,CM)
         0075    C
         0076    C          ...NORMALIZE TO A COMMON PROJECTION BY FINDING THE LAT
         0077    C          ...THROUGH THE INVERSE UTM PROJECTION
         0078    C          SET SPHEROID PARAMETERS(REF_SPHEROID)
         0079    C
         0080          CALL ADSSSP(ZSPHID)
         0081    C
         0082    C          PERFORM INVERSE UTM PROJECTION
         0083    C
         0084          CALL ADSIMP(FEAST,FNORTH,CM,FLAT,FLONG)
         0085    C
         0086    C          ...CONVERT FLOATING POINT RADIANS TO ASCII DEG,MIN ANC
         0087    C          SET LAT_COORD EQUAL TO LAT_COORD TIMES 180 DIVIDED BY
         0088    C
         0089          FLAT = FLAT*180./PI
         0090    C
         0091    C          SET LONG_COORD EQUAL TO LONG_COORD TIMES 180 DIVIDED
         0092    C
         0093          FLONG = FLONG*180./PI
         0094    C
         0095    C          ...CONVERT FROM DECIMAL TO D,M,S
         0096    C          CONVERT DECIMAL DEGREES TO DEGREES-MINUTES-SECONDS
         0097    C
         0098          CALL ADSCDD(FLAT,IDEG,MIN,SEC)
         0099    C
         0100    C          ...PUT VALUES IN LAT_LCS USING ENCODE
         0101    C          ENCODE DATA ACCORDING TO FORMAT SPECIFICATION
         0102    C
         0103          ENCODE (9,1001,LAT,ERR=9999) IDEG,MIN,SEC
         0104     1001 FORMAT (2I2,F4.1)
         0105    C
         0106    C          ...SET HEMISPHERE
         0107    C
         0108    C       IF SOUTHERN HEMISPHERE
         0109    C
         0110          IF (FLAT.LT.0.)  THEN
         0111    C          SET LAT_LCS(9) TO 'S'
         0112    C
         0113          LAT(9)='S'
         0114    C
```

```
0115     C
0116           ELSE
0117     C
0118     C           ELSE SET LAT_LCS(9) TO 'N'
0119     C
0120           LAT(9)='N'
0121           ENDIF
0122     C           ...NOW DO LONGITUDE
0123     C           CONVERT DECIMAL DEGREES TO DEGREES-MINUTES-SECONDS
0124     C
0125           CALL ADSCDD(FLONG,IDEG,MIN,SEC)
0126     C
0127     C           ...PUT VALUES IN LONG_LCS USING ENCODE FUNCTION
0128     C
0129     C           ENCODE DATA ACCORDING TO FORMAT SPECIFICATION
0130     C
0131           ENCODE (9,1002,LONG,ERR=9999) IDEG,MIN,SEC
0132      1002 FORMAT (I3,I2,F4.1)
0133     C
0134     C           ...SET HEMISPHERE
0135     C           IF WESTERN HEMISPHERE
0136     C
0137           IF (FLONG.LT.0.) THEN
0138     C
0139     C           SET LONG_LCS(10) TO 'W'
0140     C
0141           LONG(10)='W'
0142     C
0143     C           ELSE SET LONG_LCS(10) TO 'E'
0144     C
0145           ELSE
0146     C
0147           LONG(10)='E'
0148           ENDIF
0149           DO 1000 IJK=1,9
0150           IF (LONG(IJK) .EQ. ' ')  THEN
0151           LONG(IJK)='0'
0152           ENDIF
0153           IF (LAT(IJK) .EQ. ' ') THEN
0154           LAT(IJK)='0'
0155           ENDIF
0156      1000 CONTINUE
0157           RETURN
0158     C
0159     C       ERROR EXIT FOR ENCODE
0160     C
0161      9999 IERFLG=-1
0162           RETURN
0163           END
```

```
0001            SUBROUTINE ADSCNU(NORTH,IEAST,MGR,IERFLG)
0002      C
0003      C         ***************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *      ADSCNU -- PERFORM EASTING/NORTHING TO MGR CONVERSION
0007      C         *
0008      C         *  PURPOSE:
0009      C         *      TO CONVERT AN INTERNAL FLOATING POINT EASTING/NORTHING
0010      C         *      TO AN ASCII MGR
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *      AUTHOR - P. W. DENNIS
0014      C         *      LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0015      C         *      MOD LEVEL              DATE          DR NUMBERS
0016      C         *         01                 102979          DR 00009
0017      C         *
0018      C         *
0019      C         *  CALLING SEQUENCE:
0020      C         *      CALL ADSCNU (NORTH,IEAST,MGR,IERFLG)
0021      C         *      WHERE:
0022      C         *
0023      C         *      IEAST              EAST_UCS           UTM EASTING
0024      C         *
0025      C         *       NORTH             NORTH_UCS          UTM NORTHING
0026      C         *
0027      C         *      MGR                UTM_UCS            ASCII MGR STRING
0028      C         *
0029      C         *
0030      C         *
0031      C         *      IERFLG             ERR_FLAG_UCS       ERROR FLAG (-1 = ER
0032      C         *
0033      C         *  INPUT/OUTPUT:
0034      C         *
0035      C         *       NONE
0036      C         *
0037      C         *  RESTRICTIONS:
0038      C         *   (1) REFERENCE GRIDZONE IS IN SHARED GLOBAL AREA
0039      C         *   (2) REFERENCE SPHEROID IS IN SHARED GLOBAL AREA
0040      C         *
0041      C         ***************************************************************
0042      C
0043            PARAMETER PI = 3.141592654
0044      C
0045      C
0046            INCLUDE 'ZDBPRO.COM'
00100     0047  1 C
00200     0048  1 C       DUMMY COMMON ZDBPRO
00300     0049  1 C
00400     0050  1         INTEGER*4 ZRFDAY,ZIOCNT,ZYDOG,ZTSEC(4),ZTEX(5)
00500     0051  1         INTEGER*2 ZSPHID,ZYGOAT,ZTSN,ZRGN,ZRGL,ZMGRST(3,3),ZLLST(56
00600     0052  1         LOGICAL*1 ZTSIC(3),ZTDWN(25)
00700     0053  1 C
00800     0054  1         COMMON /ZDBPRO/ ZRFDAY,ZIOCNT,ZYDOG,ZTSEC,ZTEX,
00900     0055  1        2                ZSPHID,ZYGOAT,ZTSN ,ZRGN ,ZTSIC,
01000     0056  1        3                ZTDWN ,ZRGL  ,ZMGRST,ZLLST
01100     0057  1 C
```

```
0058      C
0059            BYTE MGR(2),ALPHA(24)
0060      C
0061            REAL *8 FLAT,FLONG,CMERID
0062      C
0063            INTEGER *4 IE100,N100,NORTH,IEAST
0064      C
0065      C           SET ARRAY ALPHA_CHAR EQUAL TO LETTERS 'A-Z' EXCLUDING
0066      C
0067            DATA ALPHA              / 'A','B','C','D','E','F','G','H',
0068           2                          'J','K','L','M','N','P','Q','R',
0069           3                          'S','T','U','V','W','X','Y','Z'/
0070      C
0071            FEAST = IEAST
0072            FNORTH = NORTH
0073      C
0074      C           COMPUTE THE CENTRAL MERIDIAN OF THE REFERENCE GRIDZONE
0075      C           DETERMINE THE CENTRAL MERIDIAN OF A GRIDZONE(REF_GRID_
0076      C
0077            CALL ADSCCM (ZRGN,CMERID)
0078      C
0079      C          TO FIND THE MGR COORDINATES, THE POINT MUST BE NORMALIZ
0080      C          PROJECTION BY FINDING THE LATITUDE AND LONGITUDE THEN P
0081      C          A CYLINDER TO GET A NEW EASTING/NORTHING
0082      C
0083      C
0084      C           SET SPHEROID PARAMETERS(REF_SPHEROID)
0085      C
0086            CALL ADSSSP(ZSPHID)
0087      C
0088      C     PERFORM INVERSE UTM PROJECTION (EAST_UCS,NORTH_UCS,CENT_MER
0089      C                                          LONG_COORD)
0090      C
0091            CALL ADSIMP (FEAST,FNORTH,CMERID,FLAT,FLONG)
0092      C
0093      C     GET SPHEROID INDEX FROM LAT-LONG INDEXED SPHEROID TABLE
0094      C
0095            CALL ADSGSI (FLAT,FLONG,ISPHER,NLORIG)
0096      C
0097      C              COMPUTE THE GRID NUMBER OF THE INPUT POINT
0098      C
0099      C      SET INP_GRID_NUM TO INTEGER PART OF [LONG_COORD*180 DIVIDE
0100      C                                          + 186] DIVIDED BY 6
0101      C
0102            IGN =  (FLONG*180./PI + 186.)/6.
0103      C
0104      C           IF INP_GRID_NUM IS GREATER THAN 60
0105      C
0106            IF (IGN .GT. 60) THEN
0107      C
0108      C           SET INP_GRID_NUM TO INP_GRID_NUM - 60
0109      C
0110            IGN = IGN - 60
0111      C
0112      C           ELSEIF INP_GRID_NUM IS LESS THAN 1
0113      C
0114            ELSEIF (IGN .LT. 1)  THEN
```

```
0115     C
0116     C          SET INP_GRID_NUM TO INP_GRID_NUM + 60
0117     C
0118           IGN = IGN + 60
0119     C
0120           ENDIF
0121     C          IF NOT IN REFERENCE GRID ZONE OR SPHEROID TRANSFORM TO
0122     C
0123     C
0124     C     IF INP_SPHEROID IS NOT REF_SPHEROID OR INP_GRID_NUM IS NOT
0125     C
0126           IF (ISPHER.NE.ZSPHID .OR. IGN.NE.ZRGN) THEN
0127     C
0128     C               GET ACTUAL CENTRAL MERIDIAN FOR INPUT POINT
0129     C
0130           CALL ADSCCM(IGN,CMERID)
0131     C
0132     C          SET SPHEROID PARAMETERS(INP_SPHEROID)
0133     C
0134           CALL ADSSSP(ISPHER)
0135     C
0136     C               NOW PROJECT INTO CORRECT SPHEROID
0137     C
0138     C
0139     C               PERFORM UTM PROJECTION
0140     C
0141           CALL ADSMP (FLAT,FLONG,CMERID,CEAST,CNORTH)
0142     C
0143     C          ROUND TO NEAREST TEN METERS
0144     C
0145     C       SET EASTING_NEW_COORD TO 10 TIMES NEAREST INTEGER OF(EAST
0146     C                                                            DIVI
0147     C
0148           CEAST = 10.*ANINT(CEAST/10.)
0149     C
0150     C       SET NORTHING_NEW_COORD TO 10 TIMES NEAREST INTEGER OF(NORT
0151     C                                                            DIVI
0152     C
0153           CNORTH = 10.*ANINT(CNORTH/10.)
0154     C
0155     C
0156           ELSE
0157     C
0158     C          SET EASTING_NEW_COORD TO EAST_UCS
0159     C
0160           CEAST = FEAST
0161     C
0162     C          SET NORTHING_NEW_COORD TO NORTH_UCS
0163     C
0164           CNORTH = FNORTH
0165     C
0166     C
0167           ENDIF
0168     C
0169     C          DETERMINE THE GRIDZONE'S LETTER
0170     C
0171     C     SET GRID_INDEX EQUAL TO INTEGER PART OF(LAT_COORD*180/PI_CO
```

```
0172     C
0173           NDEX = ( FLAT*180./PI + 104. )/8.
0174     C
0175     C            ACCOUNT FOR IRREGULAR GRIDZONE LABELED BY 'X'
0176     C
0177     C           IF GRID_INDEX IS GREATER THAN 22
0178     C
0179           IF (NDEX.GT.22)  THEN
0180     C
0181     C           SET GRID_INDEX EQUAL TO 22
0182     C
0183           NDEX = 22
0184     C
0185     C
0186           ENDIF
0187     C
0188     C           SET GRID_LETTER EQUAL TO ALPHA_CHAR (GRID_INDEX)
0189     C
0190           IGLET = ALPHA(NDEX)
0191     C
0192     C  DETERMINE THE 100K SQUARE WITHIN THE GRIDZONE IN WHICH THE POI
0193     C
0194     C
0195     C      FIND THE FIRST 100K SQUARE EAST OF THE CENTRAL MERIDIAN OF
0196     C
0197     C
0198           CALL ADSCFE(IGN,IENUM)
0199     C
0200     C     FIND THE EASTING ID LETTER BY COUNTING THE NUMBER OF 100K SQ
0201     C     THE EASTING COORDINATE AND ADDING THIS TO THE NUMBER CORRESP
0202     C     1ST SQUARE EAST OF THE CENTRAL MERIDIAN TO GET AN INDEX INTO
0203     C     OF LETTERS REPRESENTING THE EASTING ID LETTER
0204     C
0205     C
0206     C     SET EAST_COUNT EQUAL TO (INTEGER PART OF(EASTING_NEW_COORD +
0207     C
0208           IECNT = (CEAST + 5.) /100 000.
0209     C
0210     C           IF EASTING_NEW_COORD IS NEGATIVE
0211     C
0212           IF (CEAST .LT. 0.) THEN
0213     C
0214     C           DECREMENT EAST_COUNT
0215     C
0216           IECNT = IECNT - 1
0217     C
0218           ENDIF
0219     C
0220     C           SET EAST_100K_LET TO ALPHA_CHAR(EAST_COUNT + EAST_100K
0221     C
0222           IELET = ALPHA(IECNT + IENUM)
0223     C
0224     C        FIND THE NORTHING ID LETTER BY COUNTING THE NUMBER OF 100
0225     C        THE NORTHING COORDINATE
0226     C
0227     C
0228     C  SET NORTH_COUNT TO INTEGER PART OF [(NORTHING_NEW_COORD + 5] /
```

```
0229     C
0230           NCNT = (CNORTH + 5.)/100 000.
0231     C
0232     C           SET NORTH_COUNT2 TO NORTH_COUNT
0233     C
0234           NCNT2 = NCNT
0235     C
0236     C           IF NORTHING_NEW_COORD IS LESS THAN ZERO
0237     C
0238           IF (CNORTH .LT. 0.)  THEN
0239     C
0240     C           SET NORTH_COUNT2 EQUAL TO 99 + NORTH_COUNT2
0241     C
0242           NCNT2 = 99 + NCNT2
0243     C
0244     C
0245           ENDIF
0246     C
0247     C       DETERMINE AN INDEX TO THE TABLE OF LETTERS FOR THE NORTHI
0248     C
0249     C
0250     C           SET NORTH_INDEX EQUAL TO ONE PLUS REMAINDER OF [(NORTH
0251     C
0252     C           NORTH_LETTER_ORIG] DIVIDED BY 20]
0253     C
0254           NDEX = 1 + MOD(NCNT2 + NLORIG,20)
0255     C
0256     C           SET NORTH_100K_LET EQUAL TO ALPHA_CHAR (NORTH_INDEX)
0257     C
0258           INLET = ALPHA(NDEX)
0259     C
0260     C  FIND EASTING COORDINATE WITHIN THE 100K SQUARE BY SUBTRACTING
0261     C  OF 100,000 FROM THE EASTING COORDINATE
0262     C
0263     C
0264     C      SET EAST_100K_COORD EQUAL TO INTEGER PART OF[EASTING_NEW_C
0265     C                                          EAST_COUNT*100,000] DIVIDED
0266     C
0267           IE100 = (CEAST - 100 000.*IECNT)/10.
0268     C
0269     C      FIND MGR NORTHING COORDINATE WITHIN THE 100K SQUARE BY SUB
0270     C      MULTIPLES OF 100,000 FROM THE NORTHING COORDINATE
0271     C
0272     C
0273     C           SET NORTH_100K_COORD EQUAL TO INTEGER PART OF[NORTHING
0274     C           NORTH_COUNT*100,000 ] DIVIDED BY 10
0275     C
0276           N100 = (CNORTH - 100 000.*NCNT) /10.
0277     C
0278     C           IF NORTH_100K_COORD IS LESS THAN 0
0279     C
0280           IF (N100 .LT. 0) THEN
0281     C
0282     C           SET NORTH_100K_COORD EQUAL TO 10,000 + NORTH_100K_COOR
0283     C
0284           N100 = N100 + 10 000
0285     C
```

```
0286     C
0287           ENDIF
0288     C
0289     C        ENCODE THE COMPUTED VALUES, GRID_NUMBER, GRID_LETTER, EAS
0290     C        NORTH_100K_LET, EAST_100K_COORD, AND NORTH_100K_COORD INT
0291     C        13-CHARACTER ASCII STRING, UTM_UCS
0292     C
0293     C           ENCODE DATA ACCORDING TO FORMAT SPECIFICATION
0294     C
0295           ENCODE (5,1001,MGR(9)) N100+10 000
0296           ENCODE (5,1001,MGR(5)) IE100+10 000
0297      1001 FORMAT (I5)
0298           ENCODE (5,1002,MGR) IGN,IGLET,IELET,INLET
0299      1002 FORMAT (I2,A1,A1,A1)
0300     C
0301           RETURN
0302           END
```

```
00100    0001          SUBROUTINE ADSCUN(MGR,IN,IE,IERFLG)
00200    0002     C
00300    0003     C     ************************************************************
00400    0004     C     *
00500    0005     C     *  NAME:
00600    0006     C     *       ADSCUN -- PERFORM MGR TO EASTING/NORTHING CONVER
00700    0007     C     *
00800    0008     C     *  PURPOSE:
00900    0009     C     *       TO CONVERT AN ASCII MGR TO INTERNAL
01000    0010     C     *       EASTING/NORTHING FORMAT
01100    0011     C     *
01200    0012     C     *  DESCRIPTION:
01300    0013     C     *       AUTHOR - P. W. DENNIS
01400    0014     C     *       LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
01500    0015     C     *       MOD LEVEL              DATE          DR NUMBERS
01600    0016     C     *          01                  102979         DR 00009
01700    0017     C     *
01800    0018     C     *
01900    0019     C     *  CALLING SEQUENCE:
02000    0020     C     *       CALL ADSCUN (MGR,IN,IE,IERFLG)
02100    0021     C     *       WHERE:
02200    0022     C     *       ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
02300    0023     C     *
02400    0024     C     *       IE                 EASTING _COORD      UTM EASTIN
02500    0025     C     *
02600    0026     C     *       IN                 NORTHING_COORD     UTM NORTHING
02700    0027     C     *
02800    0028     C     *       MGR                UTM_UCS            ASCII MGR ST
02900    0029     C     *
03000    0030     C     *
03100    0031     C     *       IERFLG             ERR_FLAG_UCS       ERROR FLAG (
03200    0032     C     *
03300    0033     C     *  INPUT/OUTPUT:
03400    0034     C     *
03500    0035     C     *       NONE
03600    0036     C     *
03700    0037     C     *  RESTRICTIONS:
03800    0038     C     *
03900    0039     C     *   (1) REFERENCE GRIDZONE IS IS SHARED GLOBAL AREA
04000    0040     C     *   (2) THE REFERENCE SPHEROID IS IN THE SHARED GLOBAL
04100    0041     C     *
04200    0042     C     ************************************************************
04300    0043     C
04400    0044     C
04500    0045          INCLUDE 'ZDBPRO.COM'
00100    0046   1 C
00200    0047   1 C      DUMMY COMMON ZDBPRO
00300    0048   1 C
00400    0049   1       INTEGER*4 ZRFDAY,ZIDCNT,ZYDOG,ZTSEC(4),ZTEX(5)
00500    0050   1       INTEGER*2 ZSPHID,ZYGOAT,ZTSN,ZRGN,ZRGL,ZMGRST(3,3),ZLLST(56
00600    0051   1       LOGICAL*1 ZTSIC(3),ZTDWN(25)
00700    0052   1 C
00800    0053   1       COMMON /ZDBPRO/ ZRFDAY,ZIDCNT,ZYDOG,ZTSEC,ZTEX,
00900    0054   1      2                ZSPHID,ZYGOAT,ZTSN ,ZRGN ,ZTSIC,
01000    0055   1      3                ZTDWN ,ZRGL  ,ZMGRST,ZLLST
01100    0056   1 C
04600    0057     C
```

```
04700    0058           PARAMETER OK = 0
04800    0059           PARAMETER ERROR = -1
04900    0060     C
05000    0061           BYTE LNORTH,LEAST,IGRIDL,MGR(2)
05100    0062     C
05200    0063           REAL *8 CMERID,FLAT,FLONG
05300    0064     C
05400    0065           INTEGER *4 NORTH,IEAST,N100,IE100,IN,IE
05500    0066     C
05600    0067     C           INITIALIZE ERR_FLAG_UCS TO 'OK' (=0)
05700    0068     C
05800    0069           IERFLG = OK
05900    0070     C
06000    0071     C       CONVERT THE NUMERIC ASCII OF THE MGR STRING INTO INTEGER F
06100    0072     C       BY DECODING THE FIRST 2 CHARACTERS INTO INP_GRID_NUM, AND
06200    0073     C       CHARACTERS INTO EAST_100K_COORD AND NORTH_100K_COORD RESPE
06300    0074     C
06400    0075           DECODE(13,1001,MGR,ERR=9999)IGRIDN,IGRIDL,LEAST,LNORTH,IE10
06500    0076      1001 FORMAT(I2,3A1,2I4)
06600    0077     C
06700    0078     C     CHECK IF WITHIN ONE GRID NUMBER
06800    0079     C
06900    0080           IDIF = IABS(ZRGN-IGRIDN)
07000    0081     C
07100    0082           IF (IDIF .GT. 1) THEN
07200    0083     C
07300    0084     C     REMEMBER : ZONES 1 AND 60 ARE ADJACENT
07400    0085     C
07500    0086           IF (IDIF .NE. 59)  THEN
07600    0087           IERFLG = ERROR
07700    0088           RETURN
07800    0089           ENDIF
07900    0090           ENDIF
08000    0091     C
08100    0092     C    CONVERT THE 3RD CHARACTER OF THE MGR STRING (GRIDZONE LETTER)
08200    0093     C    GRID_LETNUM, WHERE A POSITIVE NUMBER CORRESPONDS TO THE NORTH
08300    0094     C    PHERE AND A NEGATIVE NUMBER CORRESPONDS TO THE SOUTHERN HEMIS
08400    0095     C
08500    0096     C
08600    0097     C           PERFORM GRIDZONE LETTER TO NUMBER CONVERSION(GRID_LETT
08700    0098     C                                                       ERR_FLAG_
08800    0099     C
08900    0100           CALL ADSCGL(IGRIDL,IGLN,IERFLG)
09000    0101     C
09100    0102     C           IF ERR_FLAG_UCS IS 'OK' (=0)
09200    0103     C
09300    0104           IF (IERFLG.EQ.OK) THEN
09400    0105     C
09500    0106     C
09600    0107     C       CHECK IF WITHIN ONE GRID LETTER
09700    0108     C
09800    0109           IF (IABS(ZRGL-IGLN) .GT. 1)  THEN
09900    0110           IERFLG = ERROR
10000    0111           RETURN
10100    0112           ENDIF
10200    0113     C
10300    0114     C       CONVERT THE 5TH CHARACTER OF THE UTM STRING (100K NORTHIN
```

```
10400    0115     C        AN INTEGER NORTHING, NORTH_100K_NUM
10500    0116     C
10600    0117     C           PERFORM 100K NORTHING ID LETTER TO INTEGER NORTHING CO
10700    0118     C           (GRID_LETNUM,INP_GRID_NUM,NORTH_100K_LET,NORTH_100K_NU
10800    0119     C
10900    0120                 CALL ADSCNI(IGLN,IGRIDN,CNORTH,N100KN,IERFLG)
11000    0121     C
11100    0122     C           IF ERR_FLAG_UCS IS 'OK' (=0)
11200    0123     C
11300    0124                 IF (IERFLG.EQ.OK) THEN
11400    0125     C
11500    0126     C           ...DETERMINE A NUMBER, EAST_100K_NUM, CORRESPONDING TO
11600    0127     C           ...EAST OF THE CENTRAL MERIDIAN OF THE INPUT GRIDZONE
11700    0128     C           DETERMINE THE FIRST 100K SQUARE EAST OF THE CENTRAL ME
11800    0129     C           (INP_GRID_NUM,EAST_100K_NUM)
11900    0130     C
12000    0131                 CALL ADSCFE(IGRIDN,IENUM)
12100    0132     C
12200    0133     C           ...COMPUTE THE EASTING, EAST_INT, MEASURED FROM THE CE
12300    0134     C           ...THE INPUT GRIDZONE, TO THE NEAREST 100K
12400    0135     C           COMPUTE THE EASTING TO THE NEAREST 100 KILOMETERS/
12500    0136     C           (EAST_100K_LET,EAST_100K_NUM,EAST_INT,ERR_FLAG_UCS)
12600    0137     C
12700    0138                 CALL ADSCIE(LEAST,IENUM,IEAST,IERFLG)
12800    0139     C
12900    0140     C           IF ERR_FLAG_UCS IS 'OK' (=0)
13000    0141     C
13100    0142                 IF (IERFLG.EQ.OK) THEN
13200    0143     C
13300    0144     C           SET EASTING_COORD EQUAL TO EAST_INT PLUS EAST_100K_COO
13400    0145                 CEAST = IEAST + 10 * IE100
13500    0146     C
13600    0147     C           ...COMPUTE THE NORTHING, NORTH_INT, MEASURED FROM THE
13700    0148     C           ...NEAREST 100K
13800    0149     C           COMPUTE THE NORTHING TO THE NEAREST 100 KILOMETERS/
13900    0150     C           (GRID_LETNUM,INP_GRID_NUM,NORTH_100K_NUM,NORTH_INT,INP
14000    0151     C
14100    0152                 CALL ADSCIN(IGLN,IGRIDN,N100KN,NORTH,ISPHER)
14200    0153     C
14300    0154     C           IF INP_SPHEROID IS NOT ZERO
14400    0155     C
14500    0156                 IF (ISPHER.NE.0)  THEN
14600    0157     C
14700    0158     C           SET NORTHING_COORD EQUAL TO NORTH_INT PLUS NORTH_100K_
14800    0159     C
14900    0160                 CNORTH = NORTH + 10 * N100
15000    0161     C
15100    0162     C           IF INP_GRID_NUM IS NOT EQUAL TO REF_GRID_NUM OR INP_SP
15200    0163     C
15300    0164     C            NOT EQUAL TO REF_SPHEROID
15400    0165     C
15500    0166                 IF (IGRIDN.NE.ZRGN  .OR. ISPHER.NE.ZSPHID)  THEN
15600    0167     C
15700    0168     C           ...COMPUTE THE CENTRAL MERIDIAN OF THE INPUT GRIDZONE
15800    0169     C           DETERMINE THE CENTRAL MERIDIAN OF A GRIDZONE(INP_GRID_
15900    0170     C
16000    0171                 CALL ADSCCM(IGRIDN,CMERID)
```

```
16100    0172     C
16200    0173     C            ...NORMALIZE THE EASTING/NORTHING, EASTING_COORD AND N
16300    0174     C            ...COMMON PROJECTION BY CALCULATING THE LATITUDE AND L
16400    0175     C            ...THEN A NEW EASTING/NORTHING.
16500    0176     C
16600    0177     C            SET SPHEROID PARAMETERS (INP_SPHEROID)
16700    0178     C
16800    0179                  CALL ADSSSP(ISPHER)
16900    0180     C
17000    0181     C            PERFORM INVERSE UTM PROJECTION(EASTING_COORD,NORTHING_
17100    0182     C            CENT_MERID,LAT_COORD,LONG_COORD)
17200    0183     C
17300    0184                  CALL ADSIMP(CEAST,CNORTH,CMERID,FLAT,FLONG)
17400    0185     C
17500    0186     C            ...COMPUTE THE CENTRAL MERIDIAN OF THE REFERENCE GRIDZ
17600    0187     C            DETERMINE THE CENTRAL MERIDIAN OF A GRIDZONE(REF_GRID_
17700    0188     C
17800    0189                  CALL ADSCCM(ZRGN,CMERID)
17900    0190     C
18000    0191     C            SET SPHEROID PARAMETERS (REF_SPHEROID)
18100    0192     C
18200    0193                  CALL ADSSSP(ZSPHID)
18300    0194     C
18400    0195     C            PERFORM UTM PROJECTION(LAT_COORD,LONG_COORD,CENT_MERID
18500    0196     C            EASTING_COORD,NORTHING_COORD)
18600    0197     C
18700    0198                  CALL ADSMP(FLAT,FLONG,CMERID,CEAST,CNORTH)
18800    0199     C
18900    0200                  ENDIF
19000    0201     C
19100    0202     C            SET EAST_UCS EQUAL TO EASTING_COORD
19200    0203     C
19300    0204                  IE = CEAST
19400    0205     C
19500    0206     C            SET NORTH_UCS EQUAL TO NORTHING_COORD
19600    0207     C
19700    0208                  IN = CNORTH
19800    0209     C
19900    0210                  ELSE
20000    0211     C
20100    0212     C            SET ERR_FLAG_UCS
20200    0213     C
20300    0214                  IERFLG = ERROR
20400    0215     C
20500    0216                  ENDIF
20600    0217                  ENDIF
20700    0218                  ENDIF
20800    0219            ENDIF
20900    0220            RETURN
21000    0221     C
21100    0222     C          ERROR EXIT FOR DECODE
21200    0223     C
21300    0224      9999  IERFLG = ERROR
21400    0225            RETURN
21500    0226            END
```

```
0001            SUBROUTINE ADSGSI(FLAT,FLONG,ISPHER,LNORIG)
0002      C
0003      C          ****************************************************************
0004      C          *
0005      C          *  NAME:
0006      C          *      ADSGSI -- GET SPHEROID INDEX FROM LAT-LONG INDEXED
0007      C          *                SPHEROID TABLE
0008      C          *
0009      C          *  PURPOSE:
0010      C          *      TO DETERMINE IN WHICH SPHEROID A GIVEN LAT-LONG
0011      C          *      IS AND TO RETURN THE NORTHING LETTER ORIGIN
0012      C          *
0013      C          *  DESCRIPTION:
0014      C          *      AUTHOR - P. W. DENNIS
0015      C          *      LAST MODIFIED BY P. W. DENNIS ON 08 JAN 80
0016      C          *      MOD LEVEL              DATE          DR NUMBERS
0017      C          *         01                 102979          DR 00009
0018      C          *
0019      C          *
0020      C          *  CALLING SEQUENCE:
0021      C          *      CALL ADSGSI (FLAT,FLONG,ISPHER,LNORIG)
0022      C          *      WHERE:
0023      C          *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0024      C          *
0025      C          *
0026      C          *      FLAT               LAT_COORD          LATITUDE (RADIANS)
0027      C          *
0028      C          *      FLONG              LONG_COORD         LONGITUDE (RADIANS)
0029      C          *
0030      C          *      ISPHER             SPHEROID_INDEX     INDEX OF SPHEROID
0031      C          *
0032      C          *      NLORIG             NORTH_LETTER_ORIG  ORIGIN OF NORTHING
0033      C          *                                            LETTER
0034      C          *
0035      C          *  INPUT/OUTPUT:
0036      C          *
0037      C          *       NONE
0038      C          *
0039      C          *  RESTRICTIONS:
0040      C          *   THE LAT-LONG INDEXED SPHEROID TABLE MUST RESIDE
0041      C          *   IN THE SGA
0042      C          *
0043      C          ****************************************************************
0044      C
0045            PARAMETER PI = 3.141592654
0046      C
0047            INCLUDE 'ZDBPRO.COM'
00100     0048   1 C
00200     0049   1 C       DUMMY COMMON ZDBPRO
00300     0050   1 C
00400     0051   1        INTEGER*4 ZRFDAY,ZIDCNT,ZYDOG,ZTSEC(4),ZTEX(5)
00500     0052   1        INTEGER*2 ZSPHID,ZYGOAT,ZTSN,ZRGN,ZRGL,ZMGRST(3,3),ZLLST(56)
00600     0053   1        LOGICAL*1 ZTSIC(3),ZTDWN(25)
00700     0054   1 C
00800     0055   1        COMMON /ZDBPRO/ ZRFDAY,ZIDCNT,ZYDOG,ZTSEC,ZTEX,
00900     0056   1       2               ZSPHID,ZYGOAT,ZTSN ,ZRGN ,ZTSIC,
01000     0057   1       3               ZTDWN ,ZRGL  ,ZMGRST,ZLLST
```

```
01100   0058  1 C
        0059    C
        0060    C          COVERT RADIANS TO TENTHS OF DEGREES
        0061    C
        0062    C          TENTH_DEGREES = 1800.*LONG_COORD DIVIDED BY PI_CONST
        0063    C
        0064          TEND = 1800./PI * FLONG
        0065    C
        0066    C          SET LONG_INDEX TO  -1
        0067    C
        0068          LONG = -1
        0069    C
        0070    C          DO UNTIL LL_SPHEROID_TAB(LONG_INDEX) IS LESS THAN TENTH_
        0071    C          AND TENTH_DEGREES IS LESS THAN OR EQUAL TO LL_SPHEROID_
        0072    C
        0073    C         INCREMENT LONG_INDEX BY TWO
        0074    C
        0075    C
        0076     100  CONTINUE
        0077          LONG = LONG + 2
        0078          FLOW = ZLLST(LONG)
        0079          FUP  = ZLLST(LONG+2)
        0080          IF (.NOT.(FLOW .LT. TEND .AND. TEND .LE. FUP))
        0081         1      GOTO 100
        0082    C
        0083    C
        0084    C
        0085    C
        0086    C          SET LAT_INDEX TO LL_SPHEROID_TAB(LONG_INDEX PLUS ONE) -
        0087    C
        0088          LAT = ZLLST(LONG + 1) - 3
        0089    C
        0090    C          CONVERT RADIAN LATITUDE TO TENTHS OF DEGREES
        0091    C
        0092    C          TENTH_DEGREES = 1800.*LAT_COORD DIVIDED BY PI_CONST
        0093    C
        0094          TEND = 1800./PI * FLAT
        0095    C
        0096    C          DO UNTIL LL_SPHEROID_TAB(LAT_INDEX) IS LESS THAN TENTH_
        0097    C          TENTH_DEGREES IS LESS THAN OR EQUAL TO LL_SPHEROID_TAB(
        0098    C
        0099    C          INCREMENT LAT_INDEX BY THREE
        0100    C
        0101     200  CONTINUE
        0102          LAT = LAT + 3
        0103          FLOW = ZLLST(LAT)
        0104          FUP  = ZLLST(LAT+3)
        0105          IF(.NOT.(FLOW .LT. TEND .AND. TEND .LE. FUP))
        0106         1          GOTO 200
        0107    C
        0108    C
        0109    C
        0110    C
        0111    C          SET SPHEROID_INDEX TO LL_SPHEROID_TAB(LAT_INDEX+1)
        0112    C
        0113          ISPHER = ZLLST(LAT + 1)
        0114    C
```

```
0115     C          SET NORTH_LETTER_ORIG TO LL_SPHEROID_TAB(LAT_INDEX+2)
0116     C
0117               LNORIG = ZLLST(LAT + 2)
0118     C
0119     C          IF SPHEROID_INDEX IS NEGATIVE
0120     C
0121               IF (ISPHER .LT. 0) THEN
0122     C
0123     C               ...SPHEROID JUNCTION NOT ALONG PARALLEL OR MERIDIAN
0124     C               ...SO WE NEED TO INTERPOLATE LINEARLY
0125     C
0126     C               ... THIS CAPABILITY TO BE PROVIDED LATER
0127     C
0128               ENDIF
0129               RETURN
0130               END
```

```
0001            SUBROUTINE ADSIMP(FEAST,FNORTH,CMERID,FLAT,FLONG)
0002      C
0003      C         ***************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *      ADSIMP -- PERFORM INVERSE UTM PROJECTION
0007      C         *
0008      C         *  PURPOSE:
0009      C         *      TO PROJECT THE INPUT UTM COORDINATES INTO THE
0010      C         *      EARTH
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *      AUTHOR - P. W. DENNIS
0014      C         *      LAST MODIFIED BY P. E. KING ON  5 OCT 79
0015      C         *      MOD LEVEL              DATE          DR NUMBERS
0016      C         *         01                 102979          DR 00009
0017      C         *         02                 120579          DR 00089
0018      C         *
0019      C         *
0020      C         *  CALLING SEQUENCE:
0021      C         *      CALL ADSIMP (FEAST,FNORTH,CMERID,FLAT,FLONG)
0022      C         *      WHERE:
0023      C         *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0024      C         *
0025      C         *      FEAST              EASTING_COORD      UTM EASTING
0026      C         *
0027      C         *      FNORTH             NORTHING_COORD     UTM NORTHING
0028      C         *
0029      C         *      CMERID             CENT_MERID         CENTRAL MERIDIAN
0030      C         *
0031      C         *                                            OF PROJECTION
0032      C         *
0033      C         *      FLAT               LAT_COORD          LATITUDE (RADIANS)
0034      C         *
0035      C         *      FLONG              LONG_COORD         LONGITUDE (RADIANS)
0036      C         *
0037      C         *  INPUT/OUTPUT:
0038      C         *
0039      C         *       NONE
0040      C         *
0041      C         *  RESTRICTIONS:
0042      C         *   SPHEROID PARAMETERS MUST BE SET IN COMMON ADSCEAR
0043      C         *
0044      C         ***************************************************************
0045      C
0046            PARAMETER K0=.9996
0047            INCLUDE 'ADCEAR.COM'
0048    1 C
0049    1 C
0050    1       COMMON /ADCEAR/LSPHER,AXMAJ,AXMIN,A,B,C,E2
0051    1 C
0052    1 C      PURPOSE:
0053    1 C        CONTAINS SPHEROID PARAMETERS
0054    1 C
0055    1 C
0056    1 C           MOD LEVEL          DATE        DR NUMBERS
0057    1 C              01             110979        DR 00009
```

```
0058  1 C
0059  1 C
0060  1 C          VARIABLE        PDL DATA NAME          DESCRIPTION
0061  1 C
0062  1 C          LSPHER                                 LAST SPHEROID USED
0063  1 C          AXMAJ           SEMI_MAJ               SEMI-MAJOR AXIS OF
0064  1 C                                                 CURRENT SPHEROID
0065  1 C          AXMIN           SEMI_MIN               SEMI-MINOR AXIS OF
0066  1 C                                                 CURRENT SPHEROID
0067  1 C          A               A                      1 ST MERIDIONAL ARC
0068  1 C                                                 COEFFICIENT
0069  1 C          B               B                      2 ND MERIDIONAL ARC
0070  1 C                                                 COEFFICIENT
0071  1 C          C               C                      3 RD MERIDIONAL ARC
0072  1 C                                                 COEFFICIENT
0073  1 C          E2              E2                     SPHEROID ECCENTRICITY
0074  1 C                                                 SQUARED
0075  1 C
0076  1 C
0077  1 C                    LAST MODIFIED BY P. E. KING ON 9 NOV 79
0078  1 C  ************************************************************
0079           REAL*8 PSI,BZ,KZ,KY,AQUAD,BQDB2,CQUAD,X,Y,Z,ROOT,FLAT,FLONG
0080           REAL *8 CMERID
0081 C  D      WRITE (5,*) A,B,C,AXMAJ,AXMIN
0082      C
0083      C...COMPUTE PSI (THE MERIDIONAL ARC PARAMETER)
0084      C
0085           PSI=(FNORTH+B*DSIN(2.*DBLE(FNORTH/A))+
0086          !               C*DSIN(4.*DBLE(FNORTH/A)))/A
0087      C
0088      C       COMPUTE SLOPES AND INTERCEPTS OF PROJECTION RAY
0089      C
0090           BZ = - FEAST / (3.*K0)
0091           KZ = 2.* BZ / ( DBLE(AXMAJ) * DCOS (PSI) )
0092           KY = DTAN ( PSI )
0093      C
0094      C....SOLVE QUADRATIC EQUATION FOR INTERSECTION OF PROJECTION RAY
0095      C....WITH SPHEROID; BUT FIRST CALCULATE COEFFICIENTS.
0096      C
0097           AQUAD = 1 + KY*KY + KZ*KZ
0098           BQDB2 = KZ*BZ
0099           CQUAD = BZ*BZ - DBLE(AXMAJ)*DBLE(AXMAJ)
0100           X = ( -BQDB2 + DSQRT ( BQDB2 * BQDB2 -  AQUAD*CQUAD )) / AQUAD
0101           Y = AXMIN*KY*(X / AXMAJ)
0102           Z = KZ * X + BZ
0103           ROOT = DSQRT (DBLE(AXMIN)*DBLE(AXMIN) - Y*Y)
0104           FLAT = DATAN2 (DBLE(AXMAJ/AXMIN) * Y  ,ROOT )
0105           FLONG = CMERID + DASIN ( -Z/ROOT * DBLE(AXMIN/AXMAJ))
0106           RETURN
0107           END
```

```
0001            SUBROUTINE ADSMP(FLAT,FLONG,CMERID,FEAST,FNORTH)
0002      C
0003      C         ****************************************************************
0004      C         *
0005      C         *  NAME:
0006      C         *      ADSMP -- PERFORM UTM PROJECTION
0007      C         *
0008      C         *  PURPOSE:
0009      C         *      TO PROJECT THE INPUT LAT AND LONG INTO THE
0010      C         *      TRANSVERSE PROJECTION CYLINDER
0011      C         *
0012      C         *  DESCRIPTION:
0013      C         *      AUTHOR - P. W. DENNIS
0014      C         *      LAST MODIFIED BY P. E. KING ON 28 OCT 79
0015      C         *      MOD LEVEL              DATE          DR NUMBERS
0016      C         *         01                 102979          DR 00009
0017      C         *
0018      C         *
0019      C         *  CALLING SEQUENCE:
0020      C         *      CALL ADSMP (FLAT,FLONG,CMERID,FEAST,FNORTH)
0021      C         *      WHERE:
0022      C         *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0023      C         *
0024      C         *      FEAST              EASTING_COORD      UTM EASTING
0025      C         *
0026      C         *      FNORTH             NORTHING_COORD     UTM NORTHING
0027      C         *
0028      C         *      CMERID             CENT_MERID         CENTRAL MERIDIAN
0029      C         *
0030      C         *                                            OF PROJECTION
0031      C         *
0032      C         *      FLAT               LAT_COORD          LATITUDE (RADIANS)
0033      C         *
0034      C         *      FLONG              LONG_COORD         LONGITUDE (RADIANS)
0035      C         *
0036      C         *  INPUT/OUTPUT:
0037      C         *
0038      C         *       NONE
0039      C         *
0040      C         *  RESTRICTIONS:
0041      C         *   SPHEROID PARAMETERS MUST BE SET IN COMMON ADSCEAR
0042      C         *
0043      C         ****************************************************************
0044            PARAMETER K0=.9996
0045            REAL*8 SLAT,SDLONG,CLAT,CDLONG,FLAT,FLONG,CMERID,PSI
0046            INCLUDE 'ADCEAR.COM'
0047    1 C
0048    1 C
0049    1       COMMON /ADCEAR/LSPHER,AXMAJ,AXMIN,A,B,C,E2
0050    1 C
0051    1 C      PURPOSE:
0052    1 C        CONTAINS SPHEROID PARAMETERS
0053    1 C
0054    1 C
0055    1 C          MOD LEVEL          DATE        DR NUMBERS
0056    1 C             01             110979        DR 00009
0057    1 C
```

```
0058  1 C
0059  1 C          VARIABLE       PDL DATA NAME          DESCRIPTION
0060  1 C
0061  1 C          LSPHER                                LAST SPHEROID USED
0062  1 C          AXMAJ          SEMI_MAJ               SEMI-MAJOR AXIS OF
0063  1 C                                                CURRENT SPHEROID
0064  1 C          AXMIN          SEMI_MIN               SEMI-MINOR AXIS OF
0065  1 C                                                CURRENT SPHEROID
0066  1 C          A              A                      1 ST MERIDIONAL ARC
0067  1 C                                                COEFFICIENT
0068  1 C          B              B                      2 ND MERIDIONAL ARC
0069  1 C                                                COEFFICIENT
0070  1 C          C              C                      3 RD MERIDIONAL ARC
0071  1 C                                                COEFFICIENT
0072  1 C          E2             E2                     SPHEROID ECCENTRICITY
0073  1 C                                                SQUARED
0074  1 C
0075  1 C
0076  1 C                    LAST MODIFIED BY P. E. KING ON 9 NOV 79
0077  1 C  ****************************************************************
0078    C
0079    C
0080    C....COMPUTE TRIG FUNCTIONS ONCE AND SAVE!
0081    C
0082          CLAT = DCOS(FLAT)
0083          SLAT = DSIN(FLAT)
0084          CDLONG = DCOS (FLONG - CMERID)
0085          SDLONG = DSIN (FLONG - CMERID)
0086    C
0087    C....COMPUTE PSI (THE MERIDIONAL ARC PARAMETER)
0088    C
0089          PSI=DATAN2(DBLE(AXMIN)*SLAT,DBLE(AXMAJ)*CLAT*CDLONG)
0090    C
0091    C....COMPUTE MERIDIONAL ARC (THE NORTHING)
0092    C....NORTHING_COORD = A_*PSI - B_*SIN ( 2*PSI ) - C_*SIN ( 4*PSI )
0093    C
0094          FNORTH=DBLE(A)*PSI - DBLE(B)*DSIN(2.*PSI) - C*DSIN(4.*PSI)
0095    C
0096    C....COMPUTE EASTING
0097    C
0098    C....EASTING_COORD = (3*K0*SEMI_MAJ*SDLONG*CLAT) DIVIDED BY
0099    C...(2*SQUARE ROOT OF (CLAT*CLAT*CDLONG*CDLONG+(1-E2)*SLAT*SLAT) + /
0100    C....SQUARE ROOT OF (1-E2*SLAT*SLAT))
0101    C
0102          FEAST=(3.*K0*DBLE(AXMAJ)*SDLONG*CLAT) /
0103         !         (2.*DSQRT(CLAT*CLAT*CDLONG*CDLONG+(1-E2)*SLAT*SLAT )
0104         !       + DSQRT(1-E2*SLAT*SLAT))
0105          RETURN
0106          END
```

```
0001              SUBROUTINE ADSSSP(ISPHER)
0002        C
0003        C         ***************************************************************
0004        C         *
0005        C         *  NAME:
0006        C         *      ADSSSP -- SETS SPHEROID PARAMETERS IN COMMON ADCEAR
0007        C         *
0008        C         *  PURPOSE:
0009        C         *      TO COMPUTE MERIDIONAL ARC PARAMETERS AND SQUARED
0010        C         *      ECCENTRICITY OF THE SPHEROID SPECIFIED BY ISPHER
0011        C         *
0012        C         *  DESCRIPTION:
0013        C         *      AUTHOR - P. W. DENNIS
0014        C         *      LAST MODIFIED BY P. E. KING ON  4 DEC 79
0015        C         *      MOD LEVEL              DATE          DR NUMBERS
0016        C         *         01                 102979          DR 00009
0017        C         *         02                 120479          DR 00064
0018        C         *
0019        C         *
0020        C         *  CALLING SEQUENCE:
0021        C         *      CALL ADSSSP (ISPHER)
0022        C         *      WHERE:
0023        C         *      ARGUMENT NAME      PDL DATA NAME      DESCRIPTION
0024        C         *
0025        C         *      ISPHER             INP_SPHEROID       SPHEROID INDEX
0026        C         *
0027        C         *
0028        C         *  INPUT/OUTPUT:
0029        C         *
0030        C         *       NONE
0031        C         *
0032        C         *  RESTRICTIONS:
0033        C         *   NONE
0034        C         *
0035        C         ***************************************************************
0036        C
0037              PARAMETER K0=.9996
0038              INCLUDE 'ADCEAR.COM'
0039        1 C
0040        1 C
0041        1         COMMON /ADCEAR/LSPHER,AXMAJ,AXMIN,A,B,C,E2
0042        1 C
0043        1 C       PURPOSE:
0044        1 C         CONTAINS SPHEROID PARAMETERS
0045        1 C
0046        1 C
0047        1 C          MOD LEVEL          DATE        DR NUMBERS
0048        1 C             01             110979        DR 00009
0049        1 C
0050        1 C
0051        1 C          VARIABLE       PDL DATA NAME          DESCRIPTION
0052        1 C
0053        1 C          LSPHER                                LAST SPHEROID USED
0054        1 C          AXMAJ          SEMI_MAJ               SEMI-MAJOR AXIS OF
0055        1 C                                                 CURRENT SPHEROID
0056        1 C          AXMIN          SEMI_MIN               SEMI-MINOR AXIS OF
0057        1 C                                                 CURRENT SPHEROID
```

```
0058  1 C           A               A                       1 ST MERIDIONAL ARC
0059  1 C                                                   COEFFICIENT
0060  1 C           B               B                       2 ND MERIDIONAL ARC
0061  1 C                                                   COEFFICIENT
0062  1 C           C               C                       3 RD MERIDIONAL ARC
0063  1 C                                                   COEFFICIENT
0064  1 C           E2              E2                      SPHEROID ECCENTRICITY
0065  1 C                                                   SQUARED
0066  1 C
0067  1 C
0068  1 C                    LAST MODIFIED BY P. E. KING ON 9 NOV 79
0069  1 C     ****************************************************************
0070              INCLUDE 'ADSTAB.DAT'
0071  1 C         ************************************************************
0072  1 C
0073  1 C           TABLE OF SPHEROID AXES
0074  1 C
0075  1 C         ************************************************************
0076  1 C
0077  1           DIMENSION AAXIS(9),BAXIS(9)
0078  1 C
0079  1 C                              THE SEMI-MAJOR AXES
0080  1 C
0081  1           DATA  AAXIS                /
0082  1          1                             6378388.,      !    INTERNATIONAL
0083  1          2                             6378206.,      !    CLARKE 1866
0084  1          3                             6378249.,      !    CLARKE 1880
0085  1          4                             6377276.,      !    EVEREST
0086  1          5                             6377397.,      !    BESSEL
0087  1          6                             6378160.,      !    AUSTRALIAN NATIONAL
0088  1          7                             6377397.,      !    AIRY
0089  1          8                             6378155.,      !    FISCHER
0090  1          9                             6377304. /     !    MALAYAN
0091  1 C
0092  1 C                              THE SEMI-MINOR AXES
0093  1 C
0094  1           DATA  BAXIS                /
0095  1          1                             6356912.,      !    INTERNATIONAL
0096  1          2                             6356584.,      !    CLARKE 1866
0097  1          3                             6356515.,      !    CLARKE 1880
0098  1          4                             6356075.,      !    EVEREST
0099  1          5                             6356079.,      !    BESSEL
0100  1          6                             6356775.,      !    AUSTRALIAN NATIONAL
0101  1          7                             6356257.,      !    AIRY
0102  1          8                             6356774.,      !    FISCHER
0103  1          9                             6356102. /     !    MALAYAN
0104  1 C
0105  1 C
0106  1 C                  MOD LEVEL              DATE                  DR NUMBERS
0107  1 C                     01                110979                 DR 00009
0108  1 C
0109  1 C
0110  1 C              LAST MODIFIED BY P. E. KING ON 9 NOVEMBER 79
0111  1 C
0112  1 C
0113  1 C     ****************************************************************
0114  1 C       ************************************************************
```

```
0115     C
0116     C
0117     C        THE FOLLOWING 'IF TEST' SHOULD BE PERFORMED
0118     C        IN FUTURE IMPLEMENTATIONS IN ORDER TO AVOID
0119     C        PERFORMING CALCULATIONS WHICH WILL BE REDUNDANT
0120     C        FOR A MAJORITY OF OCCURENCES
0121     C
0122     C           IF INP_SPHEROID IS NOT EQUAL TO SPHEROID_INDEX
0123     C
0124     C           SET SPHEROID_INDEX EQUAL TO INP_SPHEROID
0125              LSPHER = ISPHER
0126   C  D       WRITE (5,*) 'SET PARAMETERS FOR SPHEROID ',LSPHER
0127     C           SET SEMI_MAJ BY PERFORMING TABLE LOOK-UP INTO SPHEROID_TAB
0128              AXMAJ = AAXIS(LSPHER)
0129     C
0130     C           SET SEMI_MIN BY PERFORMING TANLE LOOK-UP INTO SPHEROID_TAB
0131     C
0132              AXMIN = BAXIS(LSPHER)
0133     C           ...COMPUTE E2 [ECCENTRICITY SQUARED]
0134     C           E2 = [ 1 - [SEMI_MIN DIVIDED BY SEMI_MAJ] ^ 2]
0135     C
0136              E2 = 1. - (AXMIN/AXMAJ)**2
0137     C
0138     C           ...COMPUTE MERIDIONAL ARC EXPANSION COEFFICIENTS
0139     C
0140     C           A_ = SEMI_MAJ*K0*[ 1 - E2 DIVIDED BY 4 -3*E2*E2 DIVIDED BY 64
0141     C
0142              A = AXMAJ*K0*(1. - E2/4. - 3.*E2*E2/64.)
0143     C
0144     C           B_ = SEMI_MAJ*K0*E2* [ 1 + E2 DIVIDED BY 4 ] DIVIDED BY 8
0145     C
0146              B = AXMAJ*K0*E2*(1. + E2/4.) /8.
0147     C
0148     C           C_ = SEMI_MAJ*K0*E2*E2 DIVIDED BY 256
0149     C
0150              C = AXMAJ*K0*E2*E2 /256.
0151     C
0152     C        ENDIF WILL GO HERE
0153     C
0154              RETURN
0155              END
```

```
0001          SUBROUTINE DRWCON(WINXY,DBRES,CONRES,ZMIN,ZMAX,ZDELT)
0002     ************************************************************************
0003     *       DRAWS ELEVATION CONTOURS                                       *
0004     ************************************************************************
0005     *       INPUTS: WINXY--MIN,MAX OF EASTING AND NORTHING,RESPECTIVELY    *
0006     *               DBRES-- DATABASE RESOLUTION, USUALLY 100M              *
0007     *               CONRES-- DISTANCE BETWEEN CONTOURS, AT LEAST DBRES     *
0008     *               ZMIN,ZMAX-- MINIMUM AND MAXIMUM ELEVATION IN DATA      *
0009     *               ZDELT-- CONTOUR RESOLUTION, USER-DEFINED               *
0010     *       OUTPUTS: NONE                                                  *
0011     *       N.B. ALL UNITS ARE IN METERS.                                  *
0012     *       *** *H. JONES     R. LINDLEY ***                               *
0013     ************************************************************************
0014          IMPLICIT INTEGER*2 (I-N)
0015            INCLUDE 'MASK.DIM'
0016   1 ************************************************************
0017   1       BYTE MASK(400,400,3)
0018   1 ************************************************************
0019          DIMENSION WINXY(4)
0020     C
0021     C             SET LOWER LEFT AND UPPER RIGHT INDICES.
0022     C
0023            ILL=1
0024            IUR=(WINXY(2)-WINXY(1))/DBRES
0025            JLL=1
0026            JUR=(WINXY(4)-WINXY(3))/DBRES
0027     C
0028     C             SET I,J INCREMENT.
0029     C
0030          IJDELTA=MAX1(CONRES/DBRES,1.)
0031     C
0032     C             SET X,Y INCREMENT
0033     C
0034          XYDELTA=DBRES*FLOAT(IJDELTA)
0035     C
0036     C             FORCE MINIMUM TO BE NON INTEGER.
0037     C
0038          ZMIN=ANINT(ZMIN)+0.5
0039     C
0040     C             FORCE Z INCREMENT TO BE INTEGER.
0041     C
0042          ZDELT=ANINT(ZDELT)
0043     C
0044     C     *DRAW CONTOURS.
0045          DO HEIGHT=ZMIN+ZDELT,ZMAX,ZDELT
0046     C
0047     C       *SET VALUE OF MASK FOR THE THREE SIDES THUS:
0048     C       *VALUE OF  0   --   NOT CHECKED
0049     C       *VALUE OF  1   --   INTERCEPT
0050     C       *VALUE OF 10   --   NO INTERCEPT
0051             DO K=1,3
0052               DO J=JLL,JUR,IJDELTA
0053                 DO I=ILL,IUR,IJDELTA
0054                   MASK(I,J,K) = 0
0055                 ENDDO
0056               ENDDO
0057             ENDDO
```

```
0058     C         *
0059     C         *      IY+1
0060     C         *      .........
0061     C         *      ..       .
0062     C         *      . .      .
0063     C         *      .  .     .
0064     C         *  2   .    .3  .  IX+1
0065     C         *      .     .  .
0066     C         *      .      . .
0067     C         *      .       ..
0068     C         *      .........
0069     C         *     IX,IY    1
0070     C         *
0071     C
0072     C         *SCAN BOTTOM EDGE FOR TRACE STARTING POINTS.
0073               IY = JLL
0074               YY=FLOAT(IY/IJDELTA)*XYDELTA
0075               DO IX=ILL,IUR,IJDELTA
0076                  ICROSS = 0
0077                  IF(MASK(IX,IY,1) .EQ. 0) THEN
0078                     CALL INTERS(IX,IY,IX+
0079              +      IJDELTA,IY,HEIGHT,FRAC,ICROSS)
0080                  ENDIF
0081                  IF(ICROSS .EQ. 0) THEN
0082                     MASK(IX,IY,1) = 10
0083                  ELSE
0084                     IENTER = 1
0085                     IFOP = 0
0086                     X=FLOAT(IX/IJDELTA)*XYDELTA
0087                     XX = X + XYDELTA * FRAC
0088                     CALL MOVE (XX,YY)
0089                     IXX=IX
0090                     IYY=IY
0091                     CALL TRACE (IXX,IYY,IENTER,IFOP,HEIGHT,MASK,
0092              $                          XYDELTA,ILL,IUR,JLL,JUR,IJDELTA)
0093                  ENDIF
0094               ENDDO
0095     C
0096     C         *SCAN SIDE 2 OF RESOLUTION ELEMENTS FOR TRACE STARTING POINTS.
0097               DO IY = JLL,JUR,IJDELTA
0098                  Y=FLOAT(IY/IJDELTA)*XYDELTA
0099                  DO IX = ILL,IUR,IJDELTA
0100     C
0101                     ICROSS = 0
0102                     IF(MASK(IX,IY,2) .EQ. 0) THEN
0103                      CALL INTERS(IX,IY,IX,
0104              +       IY+IJDELTA,HEIGHT,FRAC,ICROSS)
0105                     ENDIF
0106     C
0107                     IF(ICROSS .EQ. 0) THEN
0108                        MASK(IX,IY,2) = 10
0109                     ELSE
0110                        IFOP = 0
0111                        IENTER = 2
0112                        XX=FLOAT(IX/IJDELTA)*XYDELTA
0113                        YY = Y + XYDELTA * FRAC
0114                        CALL MOVE (XX,YY)
```

```
0115                        IXX=IX
0116                        IYY=IY
0117                        CALL TRACE (IXX,IYY,IENTER,ITOP,HEIGHT,MASK,
0118           S                        XYDELTA,ILL,IUR,JLL,JUR,IJDELTA)
0119                        ITOP = 1
0120                        IENTER = 2
0121                        CALL MOVE (XX,YY)
0122                        IXX=IX-IJDELTA
0123                        IYY=IY
0124                        CALL TRACE (IXX,IYY,IENTER,ITOP,HEIGHT,MASK,
0125           S                        XYDELTA,ILL,IUR,JLL,JUR,IJDELTA)
0126                     ENDIF
0127                  ENDDO
0128               ENDDO
0129     C
0130            ENDDO
0131            RETURN
0132            END
```

```
0001              SUBROUTINE FEATURES(INCR)
0002      ************************************************************
0003      *       THE FEATURE CODES ARE DISPLAYED ON A TEK 4027 BY     *
0004      *       DRAWING THE COLUMNS IN APPROPRIATE COLORS            *
0005      ************************************************************
0006      *       INPUTS:  INCR, THE INCRIMENT FOR MOVES AND DRAWS     *
0007      *                IT IS USUALLY SET TO 1 OR 2.                *
0008      *       OUTPUTS: NONE                                        *
0009      ************************************************************
0010              INTEGER*2 INCR
0011              DIMENSION IWIN(4)
0012              INCLUDE 'WINDO.CMN'
0013    1 ************************************************************
0014    1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND  *
0015    1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER   *
0016    1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS *
0017    1 *       THE CONTOUR INTERVAL.                                *
0018    1 ************************************************************
0019    1         DIMENSION FWINXY(4)
0020    1         COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0021    1 ************************************************************
0022              INCLUDE 'CORNER.CMN'
0023    1 ************************************************************
0024    1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE     *
0025    1 *       AREA IN THE ARRAY IBUF.                              *
0026    1         INTEGER*4 SWX,SWY
0027    1         COMMON/CORNER/SWX,SWY
0028    1 ************************************************************
0029              INTEGER*2 IX,IY,INDX,INDY,ICODE
0030      C
0031      C.....  IWIN INDEXES IBUF,WHILE FWINXY SETS THE WINDOW
0032      C.....  FOR MOVES AND DRAWS
0033      C...    THE FOLLOWING IS A KLUDGE ON A MORE FLEXIBLE VERSION
0034      C...    OF THIS ROUTINE
0035              IWIN(1)=(FWINXY(1)-SWX)/100+1
0036              IWIN(2)=(FWINXY(2)-SWX)/100
0037              IWIN(3)=(FWINXY(3)-SWY)/100+1
0038              IWIN(4)=(FWINXY(4)-SWY)/100
0039 C  D         CALL CMCLOS
0040 C  D         PRINT*,INCR,IWIN
0041 C  D         READ*,JUNK
0042 C  D         CALL CMOPEN
0043      C       FOR EACH X
0044              CALL CMOPEN
0045              DO IX=IWIN(1),IWIN(2),INCR
0046                 XI=(IX-1)*100.+SWX
0047      C          SET FEATURE CODE VALUE FOR SCAN
0048                      IC=ICODE(IWIN(3),IX)
0049                      YI=FWINXY(3)
0050      C               MOVE TO BOTTOM OF WINDOW FOR THIS SCAN
0051                      CALL MOVE(XI,YI)
0052      C               FOR EACH Y
0053                      DO IY=IWIN(3),IWIN(4),INCR
0054      C                  THE POINTS IN THE DATA BASE ARE 100M APART
0055                         YI=(IY-1)*100.+SWY
0056      C                  IF NO CHANGE,CONTINUE READING
0057                         IF(ICODE(IY,IX).EQ.IC)GOTO10
```

```
0058     C.....               ELSE
0059     C                       DRAW A LINE IN THE APPROPRIATE COLOR
0060     C                       RED FOR 'URBAN' AND GREEN FOR 'FOREST'
0061                             CALL LINCLR(IC)
0062                             CALL DRAW(XI,YI)
0063     C                    SET THE NEW FEATURE CODE
0064                          IC=ICODE(IY,IX)
0065     10                   CONTINUE
0066                       ENDDO
0067     C.....            DRAW TO THE TOP IF NECESSARY
0068                       CALL LINCLR(ICODE(IY-INCR,IX))
0069                       CALL DRAW(XI,YI)
0070               ENDDO
0071               CALL CMCLOS
0072               RETURN
0073               END
```

```
0001          SUBROUTINE FILLUP(N,VVERTS,ICOD)
0002      ************************************************************************
0003      *   N IS THE INPUT NUMBER OF ORDERED VERTICES WHICH SPECIFY THE
0004      *   BOUNDARY OF THE SIMPLE CLOSED POLYGON. SINCE THE FIRST AND LAST
0005      *   VERTEX ARE UNDERSTOOD TO BE IDENTICAL, THE NUMBER OF PHYSICAL
0006      *   VERTICES IS N-1.
0007      *   VVERTS IS THE ARRAY CONTAINING THE POLYGON VERTICES.
0008      *      X-COORDINATE OF THE K-TH VERTEX = VVERTS(K,1)
0009      *      Y-COORDINATE OF THE K-TH VERTEX =VVERTS(K,2)
0010      *   IVERT(1,*)=IVERT(N,*) IS ASSUMED.
0011      *
0012      *   THE WORLD GRID POINTS LYING WITHIN THE POLYGON ARE FILLED BY THIS
0013      *   SUBROUTINE.  THE METHOD OF OPERATION IS AS FOLLOWS. EACH VERTICAL
0014      *   LINE THROUGH THE POLYGON IS EXAMINED. IN PRACTICE, THE LINE
0015      *   INTERSECTS THE POLYGON BOUNDARY AT AN EVEN NUMBER OF POINTS
0016      *   (IF NOT, THE LINE IS SHIFTED SLIGHTLY). THEN, FROM BOTTOM TO TOP,
0017      *   WE "PAINT" THE LINE SEGMENTS BOUNDED BY THE FIRST AND SECOND
0018      *   INTERSECTIONS, BY THE THIRD AND FOURTH INTERSECTIONS, ETC.
0019      *
0020      *   THE LINE SEGMENTS WHICH FORM THE POLYGON BOUNDARY ARE ORDERED BY
0021      *   INCREASING VALUES OF X. THIS HELPS TO SPEED UP THE IDENTIFICATION
0022      *   OF INTERSECTIONS BETWEEN THE BOUNDARY SEGMENTS AND THE VERTICAL
0023      *   "PAINT LINES".
0024      ************************************************************************
0025            DIMENSION VVERTS(500,2),VERTS(500,2),LOWLI(500),ICROSS(500)
0026            DIMENSION YHOLD(20),ILIST(20)
0027              INTEGER*2 IELV,ICOD
0028              INCLUDE 'MAP.CMN'
0029      1 ***************************************************************
0030      1 *       IBUF HOLDS A 40*40KM ARRAY OF DISPLAY DATA,WITH       *
0031      1 *       THE FIRST INDEX CORRESPONDS TO NORTHING, AND          *
0032      1 *       THE SECOND TO EASTING.                                *
0033      1 ***************************************************************
0034      1       INTEGER*2 IBUF(400,400)
0035      1       COMMON /MAP/IBUF
0036      1 ***************************************************************
0037              INCLUDE 'WINDO.CMN'
0038      1 ***************************************************************
0039      1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND   *
0040      1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER    *
0041      1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS  *
0042      1 *       THE CONTOUR INTERVAL.                                 *
0043      1 ***************************************************************
0044      1       DIMENSION FWINXY(4)
0045      1       COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0046      1 ***************************************************************
0047              INCLUDE 'CORNER.CMN'
0048      1 ***************************************************************
0049      1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE      *
0050      1 *       AREA IN THE ARRAY IBUF.                               *
0051      1       INTEGER*4 SWX,SWY
0052      1       COMMON/CORNER/SWX,SWY
0053      1 ***************************************************************
0054            NS=N-1
0055      C
0056      C   FIND THE MINIMUM & MAXIMUM VALUES OF X WITHIN THE POLYGON,
0057      C   XXMIN AND XXMAX.  ALSO FIND THE CENTER-OF-MASS OF THE POLYGON VERTIC
```

```
0058     C   (XCM,YCM).
0059     C
0060           XXMIN=1.0E10
0061           XXMAX=-1.0E10
0062           YYMIN=1.0E10
0063           YYMAX=-1.0E10
0064           XCM=0.0
0065           YCM=0.0
0066           DO 10 I=1,NS
0067           XCM=XCM+VVERTS(I,1)
0068           YCM=YCM+VVERTS(I,2)
0069           IF(VVERTS(I,1).LT.XXMIN) XXMIN=VVERTS(I,1)
0070           IF(VVERTS(I,1).GT.XXMAX) XXMAX=VVERTS(I,1)
0071           IF(VVERTS(I,2).LT.YYMIN) YYMIN=VVERTS(I,2)
0072           IF(VVERTS(I,2).GT.YYMAX) YYMAX=VVERTS(I,2)
0073        10 CONTINUE
0074           XCM=XCM/NS
0075           YCM=YCM/NS
0076     C
0077     C   SHIFT EACH VERTEX SLIGHTLY (APPROXIMATELY AWAY FROM THE CM).
0078     C   THIS SHIFT AVOIDS HAVING "WORKING" VERTICIES WHICH LIE DIRECTLY ATOP
0079     C   WORLD GRID POINTS.
0080     C
0081           DO 20 I=1,N
0082           VERTS(I,1)=VVERTS(I,1) + .0001*(VVERTS(I,1)-XCM)
0083           VERTS(I,2)=VVERTS(I,2) + .0001*(VVERTS(I,2)-YCM)
0084     C
0085     C   INITIALIZE AN ARRAY TO AID IN SORTING VECTORS.
0086     C
0087           ICROSS(I)=0
0088        20 CONTINUE
0089     C
0090     C   THE POLYGON SIDE VECTOR NUMBERED I IS UNDERSTOOD TO HAVE ENDPOINTS
0091     C   VERTS(I,*) AND VERTS(I+1,*).  THERE ARE N-1 SUCH VECTORS, AND WE NOW
0092     C   SORT THEM ACCORDING TO INCREASING VALUES OF "MINIMUM X".
0093     C   THE ARRAY LOWGI(*) CONTAINS THE RESULTS OF THE SORTING.
0094     C   E.G., LOWGI(*)= 1,50,2,3,49,... WOULD MEAN THAT VECTOR NUMBER 1
0095     C   HAS THE SMALLEST LEFTMOST X-COORDINATE, VECTOR NUMBER 50 IS SECOND
0096     C   SMALLEST IN X, ETC.
0097     C
0098           DO 100 K=1,NS
0099     C                              FIND THE K-TH SMALLEST (IN X) VECTOR.
0100           XMIN=1.0E10
0101           DO 50 I=1,NS
0102           IF(ICROSS(I).EQ.1) GO TO 50
0103           X=AMIN1(VERTS(I,1),VERTS(I+1,1))
0104           IF(X.GT.XMIN) GO TO 50
0105           KEY=I
0106           XMIN=X
0107        50 CONTINUE
0108           LOWGI(K)=KEY
0109     C                             CROSS OFF THE K-TH SMALLEST VECTOR
0110     C                             FROM FURTHER CONSIDERATION.
0111           ICROSS(KEY)=1
0112       100 CONTINUE
0113     C
0114     C   FIND X-COORDINATES WHICH BRACKET THE WORLD REGION TO BE FILLED.
```

```
0115      C
0116            IXXMIN=IFIX(XXMIN/100)*100 - 100
0117            IXXMAX=IFIX(XXMAX/100)*100 + 100
0118      C
0119      C     LOOP OVER VERTICAL COLUMNS OF GRID POINTS WITHIN THE POLYGON.
0120      C
0121            KSTART=1
0122            DO 300 IC=IXXMIN,IXXMAX,100
0123            X=IC
0124      C     FIND NUMBER OF INTERSECTIONS (NINTER) OF THE VERTICAL COLUMN
0125      C     WITH THE POLYGON SIDE VECTORS.
0126          150 NINTER=0
0127            DO 200 K=KSTART,NS
0128            KS0=1
0129            I=LOWLI(K)
0130      C
0131      C           SEE IF VECTOR I INTERSECTS THE COLUMN LINE X=IC.
0132      C
0133            IF(X.LT.AMIN1(VERTS(I,1),VERTS(I+1,1))) GO TO 210
0134            IF(X.GT.AMAX1(VERTS(I,1),VERTS(I+1,1))) GO TO 200
0135      C
0136      C     AN INTERSECTION HAS BEEN FOUND. CALCULATE THE Y-COORDINATE (Y)
0137      C     OF THE INTERSECTION POINT.
0138      C
0139            X1=VERTS(I,1)
0140            X2=VERTS(I+1,1)
0141            Y1=VERTS(I,2)
0142            Y2=VERTS(I+1,2)
0143            SLOPE=(Y2-Y1)/(X2-X1)
0144            Y=SLOPE*(X-X1)+Y1
0145            NINTER=NINTER+1
0146            YHOLD(NINTER)=Y
0147      C     FOR THE FIRST INTERSECTION, REDEFINE ISTART FOR THE NEXT COLUMN.
0148            IF(NINTER.EQ.1) KS0=K
0149          200 CONTINUE
0150          210 KSTART=KS0
0151      C     MAKE SURE THAT THERE ARE AN EVEN NUMBER OF INTERSECTIONS.
0152            IF(MOD(NINTER,2).EQ.0) GO TO 220
0153            X=X+1.0
0154            GO TO 150
0155          220 IF(NINTER.EQ.0) GO TO 300
0156      C
0157      C     SORT THE Y-COORDINATES OF THE INTERSECTION POINTS BY INCREASING
0158      C     VALUE. ICROSS(*)=3,7,2,... MEANS THAT THE THIRD INTERSECTION FOUND HAS
0159      C     THE SMALLEST Y-COORDINATE, THE 7-TH INTERSECTION HAS THE NEXT
0160      C     SMALLEST Y, ETC.
0161      C     NOTE THAT NOW ICROSS(*)=1
0162            DO 225 K=1,NINTER
0163          225 ICROSS(K)=1
0164      C
0165            DO 250 K=1,NINTER
0166            YMIN=1.0E10
0167            DO 230 L=1,NINTER
0168            IF(ICROSS(L).EQ.0) GO TO 230
0169            Y=YHOLD(L)
0170            IF(Y.GT.YMIN) GO TO 230
0171            KEY=L
```

```
0172            YMIN=Y
0173          230 CONTINUE
0174            ILIST(K)=KEY
0175            ICROSS(KEY)=0
0176          250 CONTINUE
0177        C
0178        C   FOR TESTING, DRAW THE COLUMN ON THE TERMINAL SCREEN.
0179        C
0180            DO 280 K=2,NINTER,2
0181            YI=YHOLD(ILIST(K-1))
0182            Y2=YHOLD(ILIST(K))
0183
0184              IX=IC/100
0185              IY1=YHOLD(ILIST(K-1))/100
0186              IY2=YHOLD(ILIST(K))/100
0187              DO IY=IY1,IY2
0188                IBUF(IY,IX)=IBUF(IY,IX)*8+ICOD
0189              ENDDO
0190            X=IC
0191          280 CONTINUE
0192        C
0193          300 CONTINUE
0194              FWINXY(1)=SWX+XXMIN
0195              FWINXY(2)=SWX+XXMAX
0196              FWINXY(3)=SWY+YYMIN
0197              FWINXY(4)=SWY+YYMAX
0198 C  D          CALL CMCLOS
0199 C  D          PRINT*,FWINXY
0200 C  D          CALL CMOPEN
0201              RETURN
0202              END
```

```
0001            SUBROUTINE GEN
0002     ************************************************
0003     *      THIS ROUTINE GENERATES THE FILE NAMES AND  *
0004     *      RELATIVE INDICES FOR REWRITING THE DATA    *
0005     *      INTO THE TORM FILES; AND REWRITES THE DATA *
0006     ************************************************
0007            INCLUDE 'CORNER.CMN'
0008   1 ************************************************************
0009   1 *      SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE    *
0010   1 *      AREA IN THE ARRAY IBUF.                             *
0011   1        INTEGER*4 SWX,SWY
0012   1        COMMON/CORNER/SWX,SWY
0013   1 ************************************************************
0014            CHARACTER*7 MGR
0015            LOGICAL*1 ERR
0016            DO J=0,3
0017               IEAST=SWX+J*10000
0018               DO I=0,3
0019                  NORTH=SWY+I*10000
0020                  CALL UTM2MGR(IEAST,NORTH,MGR,ERR)
0021                  CALL MAPOUT(I,J,MGR,ERR)
0022               ENDDO
0023            ENDDO
0024            RETURN
0025            END
```

```
0001            SUBROUTINE GETNDX(RECNUM,INDEX,POS)
0002             IMPLICIT INTEGER*4(A-Z)
0003      C      A ROUTINE TO DETERMINE ON WHICH 500 WORD PHYSICAL RECORD
0004      C      OF UNIT 'LU' THE 5 WORD LOGICAL RECORD 'RECNUM' RESIDES.
0005      C
0006      C      SUBTRACT 1 TO TAKE CARE OF MULTIPLES OF 100
0007            N=RECNUM-1
0008            INDEX=N/100+1
0009      C      INDEX IS THE PHYSICAL RECORD INDEX
0010      C      POS IS THE POSITION OF THE LOGICAL RECORD  WITHIN THE
0011      C      PHYSICAL RECORD
0012            POS=RECNUM-(INDEX-1)*100
0013            RETURN
0014            END
```

```
0001            SUBROUTINE GETREC(LU,NUM,PREC)
0002            IMPLICIT INTEGER*4(A-Z)
0003             DIMENSION PRECNUM(3),PREC(500)
0004             DATA PRECNUM/3*0/
0005       C     A ROUTINE TO RETRIEVE PHYSICAL RECORD NUMBER 'NUM'
0006       C     FROM UNIT 'LU'
0007       C
0008       C     FIRST CHECK TO SEE IF THE PHYSICAL RECORD IS
0009       C     ALREADY IN CORE.
0010       C
0011 C     D       PRINT*,NUM,LU
0012            IF(NUM.EQ.PRECNUM(LU-1)) RETURN
0013            READ(LU'NUM) PREC
0014            PRECNUM(LU-1)=NUM
0015            RETURN
0016            END
```

```
0001            SUBROUTINE GETSUB(SRECNUM,WRDPOS,N)
0002      C*****************************************************
0003      C*****  REVISED:  6/11/82
0004      C*****  FOR USE WITH ROADHEXER
0005      C*****************************************************
0006      C
0007      C       THIS ROUTINE TAKES THE SUBNODE COORDINATES FOR
0008      C       ONE LINK AND PUTS THEM INTO THE ARRAY SUBXY
0009      C
0010            IMPLICIT INTEGER*4 (A-Z)
0011            REAL Y
0012            INTEGER*2 N
0013            INCLUDE 'LNKNOD.CMN'
0014    1 ****************************************************************
0015    1 *       ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES         *
0016    1 ****************************************************************
0017    1       INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0018    1       COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0019    1      +  ,SUBREC(500)
0020    1 ****************************************************************
0021            INCLUDE 'SUB.CMN'
0022    1 ************************************************************
0023    1 *       SUBX,SUBY THE X AND Y COORDINATES OF THE SUBNODES  *
0024    1 *       IN ONE LINK (SEE BDM DOCUMENTATION)                *
0025    1 ************************************************************
0026    1       INTEGER*2 SUBX(100),SUBY(100)
0027    1       COMMON/SUB/ SUBX,SUBY
0028    1 ************************************************************
0029  C D       PRINT*,'INPUTS:',SRECNUM,WRDPOS
0030            LU=1
0031                CALL GETREC(LU,SRECNUM,SUBREC)
0032      C     THE FIRST ENTRY IN THE SUBNODE LOGICAL RECORD IS TWICE
0033      C     THE NUMBER OF POINTS IN THE SUBNODE LIST
0034      C
0035                N=SUBREC(WRDPOS)/2
0036  C D           PRINT*,'N',N
0037
0038      C     CHECK TO SEE IF ALL OF THE LOGICAL RECORD IS WITHIN THE
0039      C     PRESENT PHYSICAL RECORD.
0040      C
0041                IF(N+WRDPOS.LE.500) THEN
0042                    DO K=1,N
0043                        L=WRDPOS+K
0044
0045                        INCLUDE 'SUBNODE.SET'
0046    1 ************************************************
0047    1 *****   UNPACKING THE SUBNODE COORDINATES
0048    1 ************************************************
0049    1 *       SETTING THE X COORDINATE
0050    1       TMP=LIB$EXTZV(0,16,SUBREC(L))
0051    1       CALL LIB$INSV(TMP,0,16,SUBX(K))
0052    1 *       SETTING THE Y COORDINATE
0053    1       TMP=LIB$EXTZV(16,16,SUBREC(L))
0054    1       CALL LIB$INSV(TMP,0,16,SUBY(K))
0055    1 ************************************************
0056                    ENDDO
0057                ELSE
```

```
0058     C            GET THE BEGINNING OF THE LOGICAL RECORD
0059                  NBEG=500-WRDPOS
0060                       DO  K=1,NBEG
0061                         L=WRDPOS+K
0062                         INCLUDE 'SUBNODE.SET'
0063    1 ************************************************
0064    1 *****   UNPACKING THE SUBNODE COORDINATES
0065    1 ************************************************
0066    1 *       SETTING THE X COORDINATE
0067    1         TMP=LIBSEXTZV(0,16,SUBREC(L))
0068    1         CALL LIBSINSV(TMP,0,16,SUBX(K))
0069    1 *       SETTING THE Y COORDINATE
0070    1         TMP=LIBSEXTZV(16,16,SUBREC(L))
0071    1         CALL LIBSINSV(TMP,0,16,SUBY(K))
0072    1 ************************************************
0073                       ENDDO
0074     C
0075     C       GET NEXT PHYSICAL SUBNODE RECORD
0076                  SRECNUM=SRECNUM+1
0077                  CALL GETREC(LU,SRECNUM,SUBREC)
0078     C       GET THE REMAINDER OF THE LOGICAL SUBNODE RECORD
0079                  NREM=N-NBEG
0080  C  D        PRINT*,'NREM',NREM,'K',K,'L',L
0081                  DO  L=1,NREM
0082                     K=NBEG+L
0083                       INCLUDE 'SUBNODE.SET'
0084    1 ************************************************
0085    1 *****   UNPACKING THE SUBNODE COORDINATES
0086    1 ************************************************
0087    1 *       SETTING THE X COORDINATE
0088    1         TMP=LIBSEXTZV(0,16,SUBREC(L))
0089    1         CALL LIBSINSV(TMP,0,16,SUBX(K))
0090    1 *       SETTING THE Y COORDINATE
0091    1         TMP=LIBSEXTZV(16,16,SUBREC(L))
0092    1         CALL LIBSINSV(TMP,0,16,SUBY(K))
0093    1 ************************************************
0094                       ENDDO
0095                  ENDIF
0096     C
0097                  RETURN
0098                  END
```

```
0001            SUBROUTINE GRIDR
0002            INCLUDE 'LNKNOD.CMN'
0003    1 ******************************************************************
0004    1 *        ARRAYS FOR THE GRID,NODE,LINK,AND SUBNODE FILES         *
0005    1 ******************************************************************
0006    1         INTEGER*4 GRID,NODREC,LNKREC,SUBREC
0007    1         COMMON /LNKNOD/GRID(128,128),NODREC(5,100),LNKREC(5,100)
0008    1       + ,SUBREC(500)
0009    1 ******************************************************************
0010      C
0011            INTEGER*4 BUFR(16384)
0012            EQUIVALENCE (GRID(1,1),BUFR(1))
0013            DO 11 IG=1,32
0014            K=(IG-1)*500
0015            READ(1'IG) (BUFR(JG),JG=K+1,K+500)
0016      11      CONTINUE
0017            READ(1'33)(BUFR(J),J=16001,16384)
0018            RETURN
0019            END
```

```
0001            SUBROUTINE HA2IJM(HADR,I,J,LEV)
0002      C     *RJUTINE(CONVERT HEX ADDRESS TO MIN LEVEL I,J COORDINATES-HA2IJM)
0003      C     ************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  19 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       HA2IJM CONVERTS A HEX ADDRESS IN OCTAL REPRESENTATION TO
0009      C     *       ITS EQUIVALENT I,J OBLIQUE COORDINATES AT THE MINIMUM LEVEL
0010      C     *       OF HEX AGGREGATION.  THESE I,J COORDINATES ARE EXPRESSED IN
0011      C     *       UNITS OF HEX DIAMETERS OF THE SMALLEST SIZE HEX IN THE
0012      C     *       CURRENT CONFIGURATION AND CORRESPOND TO THE CENTER OF THE
0013      C     *       GIVEN HEX.  THE LEVEL OF AGGREGATION OF THE HEX IS ALSO
0014      C     *       RETURNED.  HA2IJM IS THE INVERSE OF THE FUNCTION IJ42HA.
0015      C     *       THE ALGORITHM PULLS DIGITS OFF THE HEX ADDRESS ONE BY ONE
0016      C     *       FROM RIGHT TO LEFT.  AS EACH DIGIT IS PULLED OFF, IT IS
0017      C     *       CONSIDERED TO BE THE LEFTMOST DIGIT AND THEREFORE REPRE-
0018      C     *       SENT THE HEX AT THE HIGHEST LEVEL OF AGGREGATION CONTAINING
0019      C     *       THE GIVEN HEX.  ACCORDINGLY, THE I,J COORDINATES (AT THE
0020      C     *       MINIMUM LEVEL) CORRESPONDING TO THIS LARGEST SIZE HEX ARE
0021      C     *       ADDED TO RUNNING I AND J TOTALS.  IF ANOTHER HEX DIGIT IS
0022      C     *       FOUND, THEN THE PREVIOUS DIGIT(S) ACTUALLY REPRESENT HEXES
0023      C     *       OF LOWER LEVEL.  A TRANSFORMATION IS APPLIED TO SHRINK THE
0024      C     *       CURRENT I,J VECTOR TO THE NEXT LOWER LEVEL, AND THE ALGO-
0025      C     *       RITHM CONTINUES WITH THE NEW DIGIT.  THE ALGORITHM TER-
0026      C     *       MINATES WHEN NO MORE NONZERO HEX DIGITS ARE FOUND.  THE
0027      C     *       LEVEL OF THE HEX IS DETERMINED AS THE MAXIMUM NUMBER OF
0028      C     *       LEVELS OF HEX AGGREGATION MINUS THE NUMBER OF DIGITS IN
0029      C     *       THE HEX ADDRESS.  HA2IJM CHECKS TO ENSURE THAT THE INPUT
0030      C     *       HEX ADDRESS IS POSITIVE AND HAS A VALID NUMBER OF DIGITS.
0031      C     *    CALLING SEQUENCE:
0032      C     *       CALL HA2IJM(HADR,I,J,LEV)
0033      C     *    INPUT:
0034      C     *       HADR    - HEX ADDRESS FOR WHICH EQUIVALENT I,J COORDINATES
0035      C     *                 AT THE MINIMUM HEX LEVEL ARE TO BE COMPUTED
0036      C     *       NHLEV   - MAXIMUM NUMBER OF LEVELS OF HEX AGGREGATION.
0037      C     *                 (IN COMMON/HEX/)
0038      C     *       MINLEV - MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0039      C     *       IMAX(HDIG)
0040      C     *       JMAX(HDIG)
0041      C     *              - ARRAYS CONTAINING THE I,J COORDINATES (AT THE
0042      C     *                MINIMUM HEX LEVEL) OF THE CENTERS OF EACH OF THE
0043      C     *                7 HEXES OF MAXIMUM LEVEL.  (THE MAXIMUM HEX LEVEL
0044      C     *                IS NHLEV - 1.)
0045      C     *    OUTPUT:
0046      C     *       I,J     - OBLIQUE COORDINATES (AT THE MINIMUM HEX LEVEL) OF
0047      C     *                 THE GIVEN HEX ADDRESS
0048      C     *       LEV     - LEVEL OF AGGREGATION OF THE GIVEN HEX ADDRESS
0049      C     *
0050      C     ************************************************************
0051            IMPLICIT INTEGER(H,P)
0052            COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMT
0053           $R,
0054           +                 XOFI,YOFI,XOFJ,YOFJ,RIJFX,RJJFX,RIJFY,RJJFY,
0055           +                 ICON(70),JCON(70),IMAX(7),JMAX(7)
0056            DIMENSION IVAL(7),JVAL(7)
0057            EQUIVALENCE(IVAL(1),ICON(1)),(JVAL(1),JCON(1))
```

```
0001           SUBROUTINE GRIDS
0002      ************************************************************
0003      *       THIS ROUTINE JUST DRAWS THE 10KM GRID SQUARES.     *
0004      ************************************************************
0005           INTEGER*2 IX,IY,IMAX
0006           INCLUDE 'WINDO.CMN'
0007    1 ************************************************************
0008    1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND  *
0009    1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER   *
0010    1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS *
0011    1 *       THE CONTOUR INTERVAL.                                *
0012    1 ************************************************************
0013    1      DIMENSION FWINXY(4)
0014    1      COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0015    1 ************************************************************
0016           CALL CMOPEN
0017           GRSIZE=10000.
0018         YB=FWINXY(3)
0019         YT=FWINXY(4)
0020           CALL LINCLR(4)
0021         DO XL=FWINXY(1),FWINXY(2),GRSIZE
0022            CALL MOVE(XL,YB)
0023            CALL DRAW(XL,YT)
0024              IF(AMOD(XL,10000.).EQ.0.)THEN
0025    C.....       REDRAW THE GRID LINE
0026                 CALL MOVE(XL+50.,YB)
0027                 CALL DRAW(XL+50.,YT)
0028              ENDIF
0029         ENDDO
0030           XL=FWINXY(1)
0031           XR=FWINXY(2)
0032         DO YB=FWINXY(3),FWINXY(4),GRSIZE
0033            CALL MOVE(XL,YB)
0034            CALL DRAW(XR,YB)
0035              IF(AMOD(YB,10000.).EQ.0.)THEN
0036    C.....       REDRAW THE GRID LINE
0037                 CALL MOVE(XL,YB+50.)
0038                 CALL DRAW(XR,YB+50.)
0039              ENDIF
0040         ENDDO
0041    C      CALL NUMBR
0042           CALL CMCLOS
0043         RETURN
0044         END
```

```
0059     C        *INITIALIZE I,J COORDINATES TO 0
0059               I = 0
0060               J = 0
0061     C        *IF(HEX ADDRESS IS POSITIVE)THEN
0062               IF(HADR.GE.0) GOTO 1300
0063     C           *INITIALIZE LEVEL TO MAXIMUM NUMBER OF HEX LEVELS
0064                LEV = MHLEV
0065     C           *GET LEAST SIGNIFICANT (RIGHTMOST) HEX DIGIT
0066                HEX  = HADR
0067                HDIG = IAND(HEX,7)
0068     C           *LOOP UNTIL(NO MORE HEX DIGITS)
0069      1100       CONTINUE
0070     C             *DECREMENT LEVEL BY ONE
0071                  LEV = LEV - 1
0072     C             *SHRINK PREVIOUS I,J VECTOR BY ONE LEVEL
0073                  INEW = (3*I - J)/7
0074                  JNEW = (I + J + J)/7
0075     C             *ADD I,J VECTOR CORRESPONDING TO CURRENT HEX DIGIT
0076                  I = INEW + IMAX(HDIG)
0077                  J = JNEW + JMAX(HDIG)
0078     C             *GET NEXT HEX DIGIT
0079                  HEX  = ISHFT(HEX,-3)
0080                  HDIG = IAND(HEX,7)
0081     C           *ENDLOOP(HEX DIGIT LOOP)
0082                IF(HDIG.NE.0) GOTO 1100
0083     C           *IF(LEVEL OF HEX ADDRESS IS INVALID)THEN
0084                IF(LEV.GE.MINLEV) GOTO 1200
0085     C             *INCLUDE(GENERATE HEX ERROR MESSAGE - HXERR)
0086                  CALL HXERR(6HHA2IJM,2,HADR,LEV,0,0)
0087     C           *ENDIF(LEVEL CHECK)
0088      1200       CONTINUE
0089     C        *ELSE(HEX ADDRESS IS NOT POSITIVE)
0090                GOTO 1400
0091      1300     CONTINUE
0092     C             *SET RETURN LEVEL TO ZERO
0093                  LEV = 0
0094     C             *INCLUDE(GENERATE HEX ERROR MESSAGE - HXERR)
0095                  CALL HXERR(6HHA2IJM,1,HADR,0,0,0)
0096     C        *ENDIF(CHECK FOR POSITIVE HEX ADDRESS)
0097      1400     CONTINUE
0098     C     *ENDROUTINE(HA2IJM)
0099           RETURN
0100           END
```

```
0001            SUBROUTINE HA2XYL(HADR,X,Y,LEV)
0002      C     *ROUTINE(CONVERT HEX ADDRESS TO X,Y COORDINATES AND LEVEL-HA2XYL)
0003      C     ************************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  21 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       HA2XYL CONVERTS A HEX ADDRESS TO THE X,Y CARTESIAN COORDI-
0009      C     *       NATES OF THE CENTER OF THE HEX AND THE LEVEL OF AGGREGATION
0010      C     *       OF THE HEX.  THE X,Y COORDINATES ARE EXPRESSED IN METERS.
0011      C     *       THIS ROUTINE IS THE INVERSE OF THE SUBROUTINE XYL2HA.
0012      C     *       HA2XYL FIRST CALLS THE ROUTINE HA2IJM TO CONVERT THE HEX
0013      C     *       ADDRESS TO EQUIVALENT I,J OBLIQUE COORDINATES AT THE MINI-
0014      C     *       MUM HEX LEVEL AND TO RETURN THE LEVEL OF THE GIVEN HEX.
0015      C     *       ERROR CHECKING IS DONE IN THIS SUBORDINATE ROUTINE.  THEN
0016      C     *       THE I,J COORDINATES ARE CONVERTED TO X,Y COORDINATES IN
0017      C     *       METERS BY CALLING THE ROUTINE IJM2XY.
0018      C     *    CALLING SEQUENCE:
0019      C     *       CALL HA2XYL(HADR,X,Y,LEV)
0020      C     *    INPUT:
0021      C     *       HADR    - HEX ADDRESS FOR WHICH THE EQUIVALENT X,Y COORDI-
0022      C     *                 NATES AND LEVEL OF AGGREGATION ARE TO BE COMPUTED
0023      C     *    OUTPUT:
0024      C     *       X,Y     - REAL-VALUED CARTESIAN COORDINATES OF THE CENTER
0025      C     *                 OF THE GIVEN HEX EXPRESSED IN METERS
0026      C     *       LEV     - LEVEL OF AGGREGATION OF THE GIVEN HEX ADDRESS
0027      C     *
0028      C     ************************************************************************
0029            IMPLICIT INTEGER(H,P)
0030      C       *INCLUDE(CONVERT HEX ADDRESS TO MIN LEVEL I,J AND LEVEL-HA2IJM)
0031              CALL HA2IJM(HADR,I,J,LEV)
0032      C       *INCLUDE(CONVERT MIN LEVEL I,J TO X,Y COORDINATES - IJM2XY)
0033              CALL IJM2XY(I,J,X,Y)
0034      C     *ENDROUTINE(HA2XYL)
0035            RETURN
0036            END
```

```
0001            SUBROUTINE HEXIN(HREAD,IBASE,LEVEL,HSTOR)
0002      C     *ROUTINE( CONSTRUCT INTERNAL HEX ADDRESS - HEXIN)
0003      C     *   DESIGNER/PROGRAMMER\
0004      C     *      DON KRECKER  10 SEPTEMBER 1980
0005      C     *   PURPOSE\
0006      C     *      HEXIN TAKES AN INPUT HEX QUANTITY IN EITHER OCTAL OR
0007      C     *      DECIMAL REPRESENTATION AND CONSTRUCTS A HEX ADDRESS AT
0008      C     *      THE REQUESTED LEVEL IN THE REQUIRED INTERNAL FORMAT.
0009      C     *      THE INPUT HEX QUANTITY IS TREATED AS A HEX VECTOR FROM
0010      C     *      THE ORIGIN OF THE HEX COORDINATE SYSTEM, AND THEREFORE
0011      C     *      THE PRESENCE OR ABSENCE OF LEADING 7 HEX DIGITS PLAYS
0012      C     *      NO ROLE.  THE RETURN HEX ADDRESS WILL CONTAIN LEADING 7
0013      C     *      HEX DIGITS AS NEEDED TO INDICATE THE REQUESTED HEX LEVEL.
0014      C     *      THE NUMBER OF LEADING7 HEX DIGITS DEPENDS ON THE NUMBER
0015      C     *      OF LEVELS OF HEX AGGREGATION IN USE IN THE CURRENT CON-
0016      C     *      FIGURATION, AS INITIALIZED IN A DATA STATEMENT.  HEXIN
0017      C     *      ALSO CHECKS FOR INVALID INPUTS.  IN THE CASE OF AN ERROR,
0018      C     *      AN ERROR MESSAGE IS PRINTED, AND THE RETURN HEX ADDRESS
0019      C     *      IS SET TO ZERO.
0020      C     *
0021      C     ************************************************************
0022      C     *   CALLING SEQUENCE\
0023      C     *      CALL HEXIN(HREAD,IBASE,LEVEL,HSTOR)
0024      C     *   INPUT:
0025      C     *      HREAD  - HEX QUANTITY AS READ IN EITHER OCTAL OR DECIMAL
0026      C     *               REPRESENTATION, WITH OR WITHOUT LEADING 7 DIGITS
0027      C     *      IBASE  - FLAG INDICATING THAT HREAD IS IN OCTAL (0) OR
0028      C     *               DECIMAL (1) REPRESENTATION
0029      C     *      LEVEL  - LEVEL OF HEX ADDRESS TO BE CONSTRUCTED
0030      C     *   OUTPUT:
0031      C     *      HSTOR  - HEX ADDRESS AT REQUESTED LEVEL IN REQUIRED
0032      C     *               INTERNAL FORMAT, OR ZERO IF ANY ERRORS OCCURRED
0033      C     *
0034      C     ************************************************************
0035              IMPLICIT INTEGER(H,P)
0036      C     *OUTPUT DEVICE NUMBER CONSTANT
0037              DATA IRT/6/
0038      C     *NUMBER OF LEVELS OF HEX AGGREGATION CONSTANT
0039              DATA NHEXLV/10/
0040      C     *MINIMUM HEX LEVEL CONSTANT
0041              DATA MINHLV/ 2/
0042      C         *INITIALIZE RETURN HEX ADDRESS TO ZERO
0043               HSTOR = 0
0044      C         *IF(VALID LEVEL AND POSITIVE HEX QUANTITY)THEN
0045                IF(LEVEL.LT.MINHLV) GOTO 1800
0046                IF(LEVEL.GE.NHEXLV) GOTO 1800
0047                IF(HREAD.LE.0)      GOTO 1800
0048      C           *INITIALIZE MULTIPLIER CORRESPONDING TO OCTAL OR DECIMAL
0049                  MULT = 2*IBASE + 8
0050      C           *CALCULATE MAXIMUM SHIFT CONSTANT AS FUNCTION OF LEVEL
0051                  MSHIFT = 3*(NHEXLV-LEVEL)
0052      C           *INITIALIZE PARAMETERS FOR DIGIT LOOP
0053                  HLOC   = HREAD
0054                  LSHIFT = 0
0055      C           *LOOP UNTIL(ALL DIGITS CHECKED OR INVALID DIGIT FOUND)
0056       1100       CONTINUE
0057      C             *STRIP OFF NEXT DIGIT
```

```
0058                    HTMP = HLOC/MULT
0059                    HDIG = HLOC - HTMP*MULT
0060     C             *IF(DIGIT LIMIT NOT EXCEEDED)THEN
0061                    IF(LSHIFT.GE.MSHIFT) GOTO 1400
0062     C                *IF(DIGIT IS A VALID HEX DIGIT)THEN
0063                      IF(HDIG.EQ.0.OR.HDIG.GT.7) GOTO 1200
0064     C                  *INSERT DIGIT IN OUTPUT HEX ADDRESS
0065                        HSTOR = IOR(HSTOR,ISHFT(HDIG,LSHIFT))
0066     C                *ELSE(DIGIT IS INVALID)
0067                      GOTO 1300
0068      1200            CONTINUE
0069     C                  *SET RETURN HEX ADDRESS TO ZERO
0070                        HSTOR = 0
0071     C                *ENDIF(HEX DIGIT VALIDITY CHECK)
0072      1300            CONTINUE
0073     C               *ELSE(DIGIT LIMIT EXCEEDED)
0074                      GOTO 1600
0075      1400            CONTINUE
0076     C                  *IF(HEX DIGIT NOT 7)THEN
0077                        IF(HDIG.EQ.7) GOTO 1500
0078     C                    *SET RETURN HEX ADDRESS TO ZERO
0079                          HSTOR = 0
0080     C                  *ENDIF(CHECK FOR 7 HEX DIGIT)
0081      1500              CONTINUE
0082     C                *ENDIF(DIGIT LIMIT CHECK)
0083      1600             CONTINUE
0084     C                *UPDATE LOOP PARAMETERS FOR NEXT DIGIT
0085                       HLOC   = HTMP
0086                       LSHIFT = LSHIFT + 3
0087     C             *ENDLOOP(DIGIT LOOP)
0088                    IF(HLOC.NE.0.AND.HSTOR.NE.0) GOTO 1100
0089     C             *IF(NO ERROR AND LEADING 7 HEX DIGITS NEEDED)THEN
0090                    IF(HSTOR.EQ.0) GOTO 1700
0091                    IF(LSHIFT.GE.MSHIFT) GOTO 1700
0092     C                *SET UP REQUIRED LEADING 7 DIGITS
0093                      HDIG = ISHFT(1,MSHIFT-LSHIFT) - 1
0094     C                *INSERT DIGITS IN OUTPUT HEX ADDRESS
0095                      HSTOR = IOR(HSTOR,ISHFT(HDIG,LSHIFT))
0096     C             *ENDIF(ERROR AND LEADING 7 HEX DIGIT CHECK)
0097      1700          CONTINUE
0098     C          *ENDIF(VALID LEVEL AND POSITIVE HEX QUANTITY CHECK)
0099      1800       CONTINUE
0100     C          *IF(ANY ERRORS)THEN
0101                 IF(HSTOR.NE.0) GOTO 1900
0102     C             *WRITE ERROR MESSAGE
0103                   IF(IBASE.NE.0) GOTO 1810
0104                      WRITE(IRT,9001) HREAD,LEVEL
0105                   GOTO 1920
0106      1810         CONTINUE
0107                      WRITE(IRT,9002) HREAD,LEVEL
0108      1820         CONTINUE
0109     C          *ENDIF(ERROR CHECK)
0110      1900       CONTINUE
0111           RETURN
0112      9001 FORMAT(//42H *****  INVALID PARAMETERS IN HEXIN  *****/
0113          +         21H   OCTAL HEX NUMBER =,O10/
0114          +         32H   REQUESTED HEX ADDRESS LEVEL =,I10//)
```

```
HEXIN

0115      9002 FORMAT(//42H *****  INVALID PARAMETERS IN HEXIN  *****/
0116           +         23H   DECIMAL HEX NUMBER =,I10/
0117           +         32H   REQUESTED HEX ADDRESS LEVEL =,I10//)
0118            END
```

```
0001            SUBROUTINE HEX2XY(HEX,X,Y)
0002      ************************************************************
0003      *       THIS SUBROUTINE IS USED TO TRANSLATE AN INTERNAL HEX *
0004      *       ADDRESS TO STANDARD UTM COORDINATES.                 *
0005      ************************************************************
0006            IMPLICIT INTEGER(A,P)
0007            INCLUDE 'CENTER.CMN'
0008     1 ************************************************************
0009     1 *       THE CENTER OF THE HEX GRID IS AT XORIGIN,YORIGIN   *
0010     1 *       WHERE THE COORDINATES ARE IN METERS UTM RELATIVE   *
0011     1 *       TO A GIVEN GRID ZONE.                              *
0012     1 ************************************************************
0013     1       INTEGER*4 XORIGIN,YORIGIN
0014     1       COMMON/CENTER/XORIGIN,YORIGIN
0015     1       DATA XORIGIN/500000/,YORIGIN/5700000/
0016     1 C*************************************************************
0017            CALL HA2XYL(HEX,X,Y,LEV)
0018  C  D      PRINT*,'LEV IN HEX2XY: ',LEV
0019            X=X+XORIGIN
0020            Y=Y+YORIGIN
0021            RETURN
0022            END
```

```
0001            SUBROUTINE HEXINIT
0002      ****************************************************************
0003      *       THIS JUST KEEPS ALL OF THE HEXINIT.PRM JUNK OUT OF THE *
0004      *       MAIN ROUTINE. WHILE INITIALIZING THE HEX PARAMETERS.   *
0005      ****************************************************************
0006            INCLUDE 'HEX.CMN'
0007    1 ****************************************************************
0008    1 *       FOR DEFINITIONS OF VARIABLES SEE HXINIT.FOR            *
0009    1 ****************************************************************
0010    1       IMPLICIT INTEGER(H,P)
0011    1       COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMTR,
0012    1      +                XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0013    1      +                ICON(70),JCON(70),IMAX(7),JMAX(7)
0014    1 ****************************************************************
0015            INCLUDE 'HEXRAD.CMN'
0016    1       INTEGER*2 DBRES,HEXR
0017    1       COMMON/HEXRAD/DBRES,RAD2,HEXR
0018      ****************************************************************
0019      *       IWRITE:  OUTPUT DEVICE FOR ERROR MESSAGES              *
0020      *       LEVMAX:  MAXIMUM LEVEL OF HEX AGGREGATION              *
0021      *       LEVMIN:  MINIMUM   "        "   "                     *
0022      *       OLT:  LATITUDE OF THE ORIGIN HEX IN FLOATING-          *
0023      *       POINT DEGREES                                          *
0024      *       OLN:  LONGITUDE OF ORIGIN HEX                          *
0025      *       LEVSIZ:  HEX LEVEL AT WHICH THE SCALE OF THE           *
0026      *       HEX COORDINATE SYSTEM IS GIVEN                         *
0027      *       SIZHEX:  DIAMETER OF HEXES AT SIZE 'LEVSIZ' IN         *
0028      *       FLOATING-POINT METERS                                  *
0029            IWRITE=6
0030            LEVMAX=9
0031            LEVMIN=4
0032            OLT=51.45  ! LAT AND
0033            OLN=9.00   ! LON OF  32UNC00
0034            LEVSIZ=6
0035            SIZHEX=25000.
0036            CALL HXINIT(IWRITE,LEVMAX,LEVMIN,OLT,OLN,LEVSIZ,SIZHEX)
0037      ****************************************************************
0038            DBRES=100   !DATA BASE RESOLUTION
0039      *     THE TRUE RADIUS OF A 3.57 KM HEX IS 2061,BUT...
0040            HEXR=2000
0041            R=HEXR  !HEXR OVERFLOWS WHEN IT IS SQUARED
0042            RAD2=R**2
0043            RETURN
0044            END
```

```
0001            SUBROUTINE HEXOUT(HSTOR,IBASE,HWRYT)
0002      C     *ROUTINE( FORMAT HEX ADDRESS FOR OUTPUT - HEXOUT)
0003      C     ************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  11 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       HEXOUT TAKES A HEX ADDRESS IN INTERNAL FORMAT AND REFORMATS
0009      C     *       IT FOR OUTPUT.  IF REQUESTED, THE HEX ADDRESS IS CONVERTED
0010      C     *       FROM OCTAL TO DECIMAL REPRESENTATION.  LEADING 7 HEX DIGITS
0011      C     *       ARE APPENDED TO THE ADDRESS SO THAT IT IS IN STANDARD FORM
0012      C     *       BASED ON 12 LEVELS OF HEX AGGREGATION.  THE NUMBER OF LEAD-
0013      C     *       ING 7 HEX DIGITS TO BE APPENDED DEPENDS ON THE NUMBER OF
0014      C     *       LEVELS OF HEX AGGREGATION IN USE IN THE CURRENT CONFIGURA-
0015      C     *       TION, AS INITIALIZED IN A DATA STATEMENT.
0016      C     *    CALLING SEQUENCE:
0017      C     *       CALL HEXOUT(HSTOR,IBASE,HWRYT)
0018      C     *    INPUT:
0019      C     *       HSTOR  - HEX ADDRESS IN INTERNAL FORMAT
0020      C     *       IBASE  - FLAG INDICATING THAT REQUESTED OUTPUT FORMAT IS
0021      C     *                OCTAL (0) OR DECIMAL (1)
0022      C     *    OUTPUT:
0023      C     *       HWRYT  - HEX ADDRESS IN REQUESTED OUTPUT FORMAT, EITHER
0024      C     *                OCTAL OR DECIMAL, WITH STANDARD LEADING 7 HEX
0025      C     *                DIGITS APPENDED
0026      C     *
0027      C     ************************************************************
0028                  INCLUDE 'HEX.CMN'
0029      1 ************************************************************
0030      1 *       FOR DEFINITIONS OF VARIABLES SEE HXINIT.FOR          *
0031      1 ************************************************************
0032      1       IMPLICIT INTEGER(H,P)
0033      1       COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLIO,CLTO,DLNO,DIAM(10),DIAMIR,
0034      1      +           XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0035      1      +           ICON(70),JCON(70),IMAX(7),JMAX(7)
0036      1 ************************************************************
0037      C     *OUTPUT DEVICE NUMBER CONSTANT
0038            DATA IRT/6/
0039      C     *NUMBER OF LEVELS OF HEX AGGREGATION CONSTANT
0040            DATA NHEXLV/10/
0041      C     *MINIMUM HEX LEVEL CONSTANT
0042            DATA MINHLV/ 2/
0043      C       *INITIALIZE RETURN HEX ADDRESS TO ZERO
0044              HWRYT = 0
0045      C       *IF(POSITIVE HEX ADDRESS)THEN
0046              IF(HSTOR.LE.0) GOTO 1400
0047      C         *COMPUTE NUMBER OF DIGITS IN HEX ADDRESS
0048                NDIG = IFIX(0.480898*ALOG(FLOAT(HSTOR))) + 1
0049      C         *IF(VALID NUMBER OF DIGITS)THEN
0050                IF(NDIG.GT.NHEXLV-MINHLV) GOTO 1300
0051      C           *SET UP LEADING 7 DIGITS TO BE APPENDED
0052                  HDIG = ISHFT(1,3*(12-NHEXLV)) - 1
0053      C           *CONSTRUCT OUTPUT HEX ADDRESS IN OCTAL FORMAT
0054                  HWRYT = IOR(HSTOR,ISHFT(HDIG,3*NDIG))
0055      C           *IF(DECIMAL FORMAT REQUESTED)THEN
0056                  IF(IBASE.EQ.0) GOTO 1200
0057      C             *INITIALIZE CONVERSION LOOP
```

HEXOUT

```
0058                        HLOC  = HWRYT
0059                        HWRYT = 0
0060                        IPOWR = 1
0061     C                 *LOOP UNTIL(ALL DIGITS CONVERTED)
0062      1100              CONTINUE
0063     C                    *STRIP OFF NEXT DIGIT
0064                          HDIG = IAND(HLOC,7)
0065     C                    *APPEND DIGIT TO OUTPUT HEX ADDRESS
0066                          HWRYT = HWRYT + IPOWR*HDIG
0067     C                    *UPDATE LOOP PARAMETERS FOR NEXT DIGIT
0068                          HLOC  = ISHFT(HLOC,-3)
0069                          IPOWR = IPOWR*10
0070     C                  *ENDLOOP(DIGIT CONVERSION LOOP)
0071                         IF(HLOC.GT.0) GOTO 1100
0072     C                *ENDIF(DECIMAL FORMAT CHECK)
0073      1200             CONTINUE
0074     C              *ENDIF(DIGIT COUNT CHECK)
0075      1300            CONTINUE
0076     C           *ENDIF(POSITIVE HEX ADDRESS CHECK)
0077      1400        CONTINUE
0078      1500        CONTINUE
0079           RETURN
0080      9001 FORMAT(//44H *****  INVALID HEX ADDRESS IN HEXOUT  *****/
0081          +         35H   HEX ADDRESS IN INTERNAL FORMAT =,O12//)
0082           END
```

```
0001              SUBROUTINE HEXREAD(HSTOR,SIDES,LU)
0002        C*********************************************
0003        C*****  THIS ROUTINE IS DESIGNED TO READ THE
0004        C*****  HEX NUMBER AND CONNECTIVITY OF ITS
0005        C*****  SIDES FROM THE FILE 'HEXROAD.DAT'
0006        C*********************************************
0007        C
0008              IMPLICIT INTEGER(H,P)
0009              INTEGER*4 SIDES
0010        C
0011              CALL HEXOUT(HSTOR,1,HEX)
0012              READ(UNIT=LU,KEY=HEX,KEYID=0,IOSTAT=IOS
0013             +  ,ERR=999) HEX,SIDES
0014              CALL HEXIN(HEX,1,4,HSTOR)
0015        C
0016        C         IF ALL GOES WELL...
0017              RETURN
0018        C
0019        C         IF NOT...
0020        999       CONTINUE
0021        C         ERROR CODE 36 IS RETURNED ON AN ATTEMPT TO
0022        C         READ A NONEXISTANT RECORD. (AND MAYBE FOR
0023        C         OTHER REASONS,TOO.)
0024        C
0025              SIDES=0
0026              IF(IOS.EQ.36)THEN
0027                WRITE(UNIT=LU)HEX,SIDES
0028              ELSE
0029                CALL LIB$SIGNAL(%VAL(IOS))
0030              ENDIF
0031              RETURN
0032              END
```

```
0001            SUBROUTINE HEXWRITE(HSTOR,SIDES,LU)
0002      C*********************************************
0003      C*****  THIS ROUTINE IS DESIGNED TO WRITE THE
0004      C*****  HEX NUMBER AND THE CONNECTIVITY OF ITS
0005      C*****  SIDES TO THE FILE 'HEXROAD.DAT'.
0006      C*********************************************
0007      C
0008            IMPLICIT INTEGER (H,P)
0009            INTEGER*4 SIDES
0010      C
0011            CALL HEXOUT(HSTOR,1,HEX)
0012            WRITE(UNIT=LU,IOSTAT=IOS,ERR=999)HEX,SIDES
0013      C
0014      C     IF ALL GOES WELL...
0015            RETURN
0016      C
0017      C     IF NOT...
0018      999   CONTINUE
0019            IF(IOS.EQ.50)THEN
0020              CALL HEXREAD(HSTOR,ISIDES,LU)!ISIDES IS A DUMMY
0021              REWRITE(UNIT=LU)HEX,SIDES
0022            ELSE
0023              CALL LIB$SIGNAL(%VAL(IOS))
0024            ENDIF
0025            RETURN
0026            END
```

```
0001            INTEGER FUNCTION HXADD(HEXA,HEXB)
0002      C     *ROUTINE(ADD TWO OCTAL HEX NUMBERS - HXADD)
0003      C     ************************************************************
0004      C     *
0005      C     *   DESIGNER/PROGRAMMER:
0006      C     *      DON KRECKER  11 SEPTEMBER 1980
0007      C     *   PURPOSE:
0008      C     *      HXADD ADDS TWO HEX NUMBERS EXPRESSED IN OCTAL REPRESENTA-
0009      C     *      TION.  THE ALGORITHM FIRST ADDS COLUMNS OF HEX DIGITS IN
0010      C     *      PARALLEL TO GET HEX SUM DIGITS.  THE CORRESPONDING HEX
0011      C     *      CARRY DIGITS ARE THEN CALCULATED USING LOGICAL OPERATIONS.
0012      C     *      IF NOT ALL CARRY DIGITS ARE ZERO, THEY ARE SHIFTED ONE
0013      C     *      COLUMN LEFT AND TREATED AS A NEW ADDEND TO BE ADDED TO THE
0014      C     *      SUM DIGITS.  THE PROCEDURE CONTINUES UNTIL NO NEW CARRIES
0015      C     *      ARE GENERATED.  IF N IS THE MAXIMUM NUMBER OF HEX DIGITS
0016      C     *      IN EITHER ADDEND, THE ALGORITHM WILL TERMINATE IN AT MOST
0017      C     *      N+1 STEPS.  THE HEX SUM WILL CONTAIN N OR N+1 HEX DIGITS,
0018      C     *      AND ANY N+1ST HEX DIGIT WILL NOT BE A 7.
0019      C     *      GIVEN A PAIR OF HEX DIGITS, HA AND HB, THEIR HEX SUM DIGIT
0020      C     *      IS CALCULATED BY ADDITION MODULO 7 WITH THE RESULT IN THE
0021      C     *      RANGE 1 THROUGH 7 (RATHER THAN 0 THROUGH 6).
0022      C     *         HSUM(HA,HB)=HA+HB(MOD 7)
0023      C     *      THE CORRESPONDING HEX CARRY DIGIT IS CALCULATED BY A SERIES
0024      C     *      OF LOGICAL OPERATIONS.
0025      C     *         HCAR(HA,HB)=XOR(OR(HA,HB),AND(XOR(HA,HB),HSUM(HA,HB)))
0026      C     *      IN SOME INSTANCES THIS FORMULA WILL GIVE A CARRY DIGIT
0027      C     *      OF 7 WHICH MUST BE RESET TO 0.
0028      C     *   CALLING SEQUENCE:
0029      C     *      HXADD = HXADD(HEXA,HEXB)
0030      C     *   INPUT:
0031      C     *      HEXA   - FIRST HEX NUMBER TO BE ADDED
0032      C     *      HEXB   - SECOND HEX NUMBER TO BE ADDED
0033      C     *   OUTPUT:
0034      C     *      HXADD  - HEX SUM OF HEXA AND HEXB
0035      C     *
0036      C     ************************************************************
0037            IMPLICIT INTEGER(H,P)
0038      C     *MASK OF OCTAL 1 DIGITS
0039            DATA M1/'1111111111'O/
0040      C     *MASK OF OCTAL 3 DIGITS
0041            DATA M3/'3333333333'O/
0042      C     *MASK OF OCTAL 4 DIGITS
0043            DATA M4/'4444444444'O/
0044      C       *INITIALIZE ADDENDS AS LOCAL VARIABLES
0045              HA = HEXA
0046              HB = HEXB
0047      C       *GENERATE MASK OF SIGNIFICANT HEX DIGIT POSITIONS
0048              LOR  = IOR(HA,HB)
0049              LOR3 = IAND(LOR,M3)
0050              MDIG = IAND(IOR(LOR3+M3,LOR),M4)
0051      C       *SET UP HEX DIGIT 7 IN NEXT MOST SIGNIFICANT POSITION
0052              HCHK = (MDIG - ISHFT(MDIG,-3)) * 14
0053      C       *LOOP UNTIL(NO HEX CARRIES TO BE ADDED IN)
0054       1100   CONTINUE
0055      C         *EVALUATE BASIC LOGICAL FUNCTIONS OF ADDENDS
0056                LOR  = IOR(HA,HB)
0057                LOR3 = IAND(LOR,M3)
```

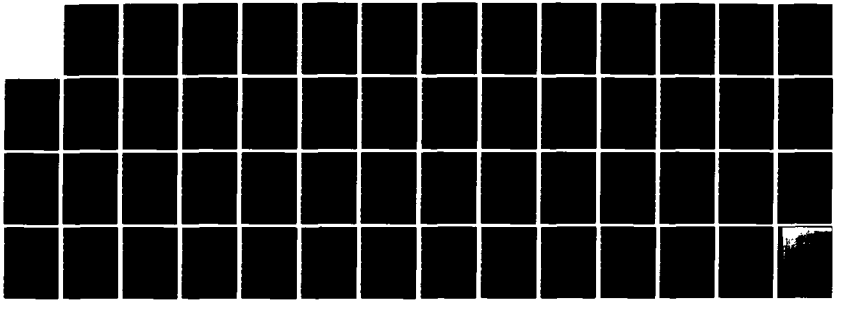
```
0058                LAND  = IAND(HA,HB)
0059                LAND4 = IAND(LAND,M4)
0060                LEOR  = IEOR(HA,HB)
0061                LEOR4 = IAND(LEOR,M4)
0062     C          **COMPUTE HEX SUM DIGITS
0063     C             *ADD DIGITS IN EACH COLUMN MODULO 8 (NO COLUMN OVERFLOWS)
0064                   HA = IEOR(IAND(HA,M3)+IAND(HB,M3),LEOR4)
0065     C             *GENERATE MASK OF COLUMNS WHICH OVERFLOW WHEN ADDED
0066                   MDIG = IOR(IAND(LEOR4,NOT(HA)),LAND4)
0067     C             *INCREMENT COLUMNS WITH OVERFLOW TO GET SUM MODULO 7
0068                   HA = HA + ISHFT(MDIG,-2)
0069     C          **END BLOCK(COMPUTE HEX SUM DIGITS)
0070     C          **COMPUTE HEX CARRY DIGITS
0071     C             *COMPUTE GENERALIZED CARRY DIGITS (POSSIBLY WITH 7S)
0072                   HB = IEOR(LOR,IAND(LEOR,HA))
0073     C             *GENERATE MASK OF COLUMNS GIVING CARRY DIGIT 7
0074                   MDIG = IAND(IAND(LOR,LOR3+M1),MDIG)
0075     C             *RESET CARRY DIGITS 7 TO 0
0076                   HB = IEOR(HB,ISHFT(MDIG,-2)*7)
0077     C          **END BLOCK(COMPUTE HEX CARRY DIGITS)
0078     C          *SHIFT CARRY DIGITS ONE COLUMN LEFT TO FORM NEW ADDEND
0079                HB = ISHFT(HB,3)
0080     C       *ENDLOOP(ADDITION UNTIL NO MORE CARRIES LOOP)
0081                IF(HB.NE.0) GOTO 1100
0082     C       *REMOVE EXTRANEOUS LEADING 7 FROM SUM IF PRESENT
0083                IF(HA.GT.HCHK) HA = HA - HCHK
0084     C       *SET RETURN VALUE TO HEX SUM
0085                HXADD = HA
0086     C    *ENDROUTINE(HXADD)
0087              RETURN
0088              END
```

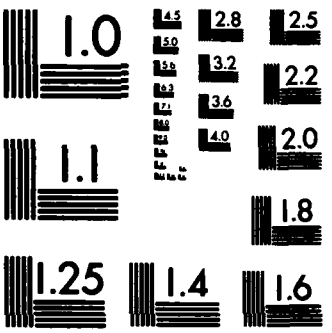
```
0001            SUBROUTINE HXERR(NAMSUB,ICASE,IPAR1,IPAR2,IPAR3,IPAR4)
0002      C     *ROUTINE(GENERATE HEX ERROR MESSAGE - HXERR)
0003      C     ************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  24 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       HXERR WRITES AN ERROR MESSAGE DESCRIBING AN ERROR WHICH HAS
0009      C     *       BEEN DETECTED IN ONE OF THE HEX LIBRARY ROUTINES.  IT ALSO
0010      C     *       CALLS A USER DEBUG ROUTINE, HXDBUG, FOR ADDITIONAL ERROR
0011      C     *       PROCESSING.  A STUB VERSION OF HXDBUG IS INCLUDED IN THE
0012      C     *       HEX LIBRARY IN CASE THE USER DOES NOT PROVIDE A VERSION TO
0013      C     *       OVERRIDE IT.
0014      C     *    CALLING SEQUENCE:
0015      C     *       CALL HXERR(NAMSUB,ICASE,IPAR1,IPAR2,IPAR3,IPAR4)
0016      C     *    INPUT:
0017      C     *       NAMSUB - NAME OF THE HEX LIBRARY ROUTINE IN WHICH THE ERROR
0018      C     *                WAS DETECTED.  THIS MAY BE A LOWER LEVEL ROUTINE
0019      C     *                INSTEAD OF A HEX ROUTINE CALLED DIRECTLY FROM OUT-
0020      C     *                SIDE THE HEX LIBRARY.  THIS PARAMETER IS PASSED
0021      C     *                USING A 6H HOLLERITH CONSTANT.
0022      C     *       ICASE  - CASE NUMBER IDENTIFYING THE TYPE OF ERROR WHICH
0023      C     *                WAS DETECTED:
0024.     C     *                1  ZERO OR NEGATIVE HEX ADDRESS
0025      C     *                2  HEX ADDRESS WITH HEX LEVEL OUT OF RANGE
0026      C     *                3  HEX LEVEL OUT OF RANGE
0027      C     *                4  TWO HEX CENTERS COINCIDE
0028      C     *                5  TWO HEX ADDRESSES AT DIFFERENT HEX LEVELS
0029      C     *                6  TWO HEX ADDRESSES COINCIDE
0030      C     *       IPAR1,IPAR2,IPAR3,IPAR4
0031      C     *                - PARAMETERS WHICH GIVE ADDITIONAL INFORMATION ABOUT
0032      C     *                THE ERROR.  THE MEANING OF THESE PARAMETERS IS
0033      C     *                DEPENDENT ON THE TYPE OF ERROR:
0034      C     *                ICASE=1 (ZERO OR NEGATIVE HEX ADDRESS)
0035      C     *                        IPAR1=HEX ADDRESS
0036      C     *                        IPAR2=IPAR3=IPAR4=0
0037      C     *                ICASE=2 (HEX ADDRESS WITH LEVEL OUT OF RANGE)
0038      C     *                        IPAR1=HEX ADDRESS
0039      C     *                        IPAR2=LEVEL OF HEX ADDRESS
0040      C     *                        IPAR3=IPAR4=0
0041      C     *                ICASE=3 (HEX LEVEL OUT OF RANGE)
0042      C     *                        IPAR1=HEX LEVEL
0043      C     *                        IPAR2=IPAR3=IPAR4=0
0044      C     *                ICASE=4 (HEX CENTERS COINCIDE)
0045      C     *                        IPAR1=ADDRESS OF FIRST HEX
0046      C     *                        IPAR2=ADDRESS OF SECOND HEX
0047      C     *                        IPAR3=IPAR4=0
0048      C     *                ICASE=5 (HEX ADDRESSES AT DIFFERENT LEVELS)
0049      C     *                        IPAR1=FIRST HEX ADDRESS
0050      C     *                        IPAR2=LEVEL OF FIRST HEX ADDRESS
0051      C     *                        IPAR3=SECOND HEX ADDRESS
0052      C     *                        IPAR4=LEVEL OF SECOND HEX ADDRESS
0053      C     *                ICASE=6 (HEX ADDRESSES COINCIDE)
0054      C     *                        IPAR1=COMMON HEX ADDRESS
0055      C     *                        IPAR2=IPAR3=IPAR4=0
0056      C     *       IHXOUT - OUTPUT DEVICE NUMBER TO WHICH HEX ERROR MESSAGES
0057      C     *                ARE TO BE WRITTEN.  (IN COMMON/HEX/)
```

```
0058     C     *
0059     C     ***************************************************************
0060           IMPLICIT INTEGER(H,P)
0061           COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMI
0062          $R,
0063          +                 XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0064          +                 ICON(70),JCON(70),IMAX(7),JMAX(7)
0065           DIMENSION IVAL(7),JVAL(7)
0066           INTEGER*2 NAMSUB(3)
0067           EQUIVALENCE(IVAL(1),ICON(1)),(JVAL(1),JCON(1))
0068     C       *WRITE ERROR MESSAGE HEADING
0069             WRITE(IHXOUT,9000)
0070     C       *CASE(TYPE OF ERROR)
0071             GOTO (1100,1200,1300,1400,1500,1600) ICASE
0072     C         *TYPE = ZERO OR NEGATIVE HEX ADDRESS
0073      1100      CONTINUE
0074     C            *WRITE MESSAGE AND INVALID HEX ADDRESS
0075                  WRITE(IHXOUT,9001) NAMSUB,IPAR1
0076     C         *TYPE = HEX ADDRESS WITH LEVEL OUT OF RANGE
0077               GOTO 1700
0078      1200      CONTINUE
0079     C            *WRITE MESSAGE AND INVALID HEX AND LEVEL
0080                  WRITE(IHXOUT,9002) NAMSUB,IPAR1,IPAR2
0081     C         *TYPE = HEX LEVEL OUT OF RANGE
0082               GOTO 1700
0083      1300      CONTINUE
0084     C            *WRITE MESSAGE AND INVALID HEX LEVEL
0085                  WRITE(IHXOUT,9003) NAMSUB,IPAR1
0086     C         *TYPE = HEX CENTERS COINCIDE
0087               GOTO 1700
0088      1400      CONTINUE
0089     C            *WRITE MESSAGE AND INVALID HEX PAIR
0090                  WRITE(IHXOUT,9004) NAMSUB,IPAR1,IPAR2
0091     C         *TYPE = HEX ADDRESSES AT DIFFERENT LEVELS
0092               GOTO 1700
0093      1500      CONTINUE
0094     C            *WRITE MESSAGE AND INVALID HEXES AND LEVELS
0095                  WRITE(IHXOUT,9005) NAMSUB,IPAR1,IPAR2,IPAR3,IPAR4
0096     C         *TYPE = HEX ADDRESSES COINCIDE
0097               GOTO 1700
0098      1600      CONTINUE
0099     C            *WRITE MESSAGE AND COMMON HEX ADDRESS
0100                  WRITE(IHXOUT,9006) NAMSUB,IPAR1
0101     C       *END CASE(TYPE OF ERROR)
0102      1700    CONTINUE
0103     C       *INCLUDE(USER HEX DEBUG ROUTINE - HXDBUG)
0104             CALL HXDBUG(NAMSUB,ICASE,IPAR1,IPAR2,IPAR3,IPAR4)
0105     C    *ENDROUTINE(HXERR)
0106           RETURN
0107      9000 FORMAT(54H0++++++++++     HXERR - ERROR DETECTED IN HEX ROUTINE:,
0108          +       15H     ++++++++++,/)
0109      9001 FORMAT(5X,3A2,47H HAS BEEN PASSED A ZERO OR NEGATIVE HEX ADDRESS,
0110          +       /,5X,5HHEX =,O12)
0111      9002 FORMAT(5X,3A2,47H HAS BEEN PASSED A HEX ADDRESS WITH AN INVALID ,
0112          +       6HLEVEL,/,5X,5HHEX =,O12,9H  LEVEL =,I3)
0113      9003 FORMAT(5X,3A2,37H HAS BEEN PASSED AN INVALID HEX LEVEL,/,5X,
0114          +       7HLEVEL =,I8)
```

AD-A132 940 CORDIVEM EUROPEAN TERRAIN DATA(U) COMBINED ARMS 3/3
OPERATIONS RESEARCH ACTIVITY FORT LEAVENWORTH KS
W J THOMSON 1983 CAORA/TP-2-83

UNCLASSIFIED F/G 15/7 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
HXERR

0115      9004 FORMAT(5X,3A2,45H HAS BEEN PASSED HEX ADDRESSES WHOSE CENTERS ,
0116           +         8HCOINCIDE,/,5X,6HHEXA =,O12,6H  HEXB =,O12)
0117      9005 FORMAT(5X,3A2,44H HAS BEEN PASSED HEX ADDRESSES AT DIFFERENT ,
0118           +         6HLEVELS,/,5X,6HHEXA =,O12,10H  LEVELA =,I3,8H  HEXB =,
0119           +         O12,10H  LEVELB =,I3)
0120      9006 FORMAT(5X,3A2,45H HAS BEEN PASSED HEX ADDRESSES WHICH COINCIDE,/,
0121           +         5X,13HHEXA = HEXB =,O12)
0122            END
```

```
0001            SUBROUTINE HXINIT(IWRITE,LEVMAX,LEVMIN,DLT,DLN,LEVSIZ,SIZHEX)
0002      C     *ROUTINE(INITIALIZE HEX LIBRARY PARAMETERS - HXINIT)
0003      C     ************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  25 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       HXINIT INITIALIZES PARAMETERS FOR A GIVEN CONFIGURATION
0009      C     *       OF THE HEX LIBRARY.  A PROGRAM USING THE HEX LIBRARY MUST
0010      C     *       CALL HXINIT BEFORE CALLING ANY OTHER HEX LIBRARY ROUTINES.
0011      C     *       THE INITIALIZATION REQUIRES INPUT PARAMETERS SPECIFYING
0012      C     *       THE DEVICE NUMBER TO WHICH ERROR MESSAGES ARE TO BE WRIT-
0013      C     *       TEN, THE MAXIMUM AND MINIMUM HEX LEVELS, THE LATITUDE AND
0014      C     *       LONGITUDE OF THE ORIGIN OF THE COORDINATE SYSTEM, AND THE
0015      C     *       DIAMETER OF HEXES AT SOME CONVENIENT LEVEL OF AGGREGATION.
0016      C     *       THESE AND/OR FUNCTIONS OF THESE PARAMETERS ARE SAVED IN
0017      C     *       THE COMMON BLOCK /HEX/, WHICH IS RESERVED FOR HEX LI-
0018      C     *       BRARY USE.
0019      C     *    CALLING SEQUENCE:
0020      C     *       CALL HXINIT(IWRITE,LEVMAX,LEVMIN,DLT,DLN,LEVSIZ,SIZHEX)
0021      C     *    INPUT:
0022      C     *       IWRITE - DEVICE NUMBER TO WHICH HEX ERROR MESSAGES ARE TO
0023      C     *                BE WRITTEN
0024      C     *       LEVMAX - MAXIMUM LEVEL OF HEX AGGREGATION.  THE MOST SIG-
0025      C     *                NIFICANT DIGIT IN HEX ADDRESSES WILL REPRESENT
0026      C     *                A HEX AT THIS LEVEL.  NOTE THAT THIS TOGETHER
0027      C     *                WITH THE DIAMETER OF HEXES AS SPECIFIED BY LEVSIZ
0028      C     *                AND SIZHEX WILL BOUND THE AREA COVERED BY THE HEX
0029      C     *                COORDINATE SYSTEM.
0030      C     *       LEVMIN - MINIMUM LEVEL OF HEX AGGREGATION.  THE CONFIGURA-
0031      C     *                TION WILL TREAT HEXES AT THIS LEVEL AS REGULAR
0032      C     *                HEXAGONS.  LARGER HEXES AT HIGHER LEVELS WILL ONLY
0033      C     *                APPROXIMATE REGULAR HEXAGONS IN SHAPE.
0034      C     *       DLT    - LATITUDE OF THE ORIGIN OF THE HEX COORDINATE
0035      C     *                SYSTEM EXPRESSED IN DEGREES AS A FLOATING POINT
0036      C     *                NUMBER
0037      C     *       DLN    - LONGITUDE OF THE ORIGIN OF THE HEX COORDINATE
0038      C     *                SYSTEM EXPRESSED IN DEGREES AS A FLOATING POINT
0039      C     *                NUMBER
0040      C     *       LEVSIZ - HEX LEVEL IN TERMS OF WHICH THE SCALE OF THE HEX
0041      C     *                COORDINATE SYSTEM IS GIVEN
0042      C     *       SIZHEX - DIAMETER OF HEXES AT LEVEL LEVSIZ EXPRESSED IN
0043      C     *                METERS AS A FLOATING POINT NUMBER.  DIAMETERS OF
0044      C     *                HEXES AT OTHER LEVELS ARE COMPLETELY DETERMINED
0045      C     *                GIVEN THIS ONE DIAMETER.
0046      C     *    OUTPUT:
0047      C     *       IHXOUT - OUTPUT DEVICE NUMBER TO WHICH HEX ERROR MESSAGES
0048      C     *                ARE TO BE WRITTEN.  (IN COMMON/HEX/)
0049      C     *       NHLEV  - MAXIMUM NUMBER OF LEVELS OF HEX AGGREGATION.
0050      C     *                THIS INCLUDES LEVMAX THROUGH LEVEL 0 EVEN IF
0051      C     *                LEVMIN IS GREATER THAN 0.  (IN COMMON/HEX/)
0052      C     *       MINLEV - MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0053      C     *       SLT0   - SINE OF THE LATITUDE OF THE ORIGIN OF THE HEX
0054      C     *                COORDINATE SYSTEM.  (IN COMMON/HEX/)
0055      C     *       CLT0   - COSINE OF THE LATITUDE OF THE ORIGIN OF THE HEX
0056      C     *                COORDINATE SYSTEM.  (IN COMMON/HEX/)
0057      C     *       DLN0   - LONGITUDE OF THE ORIGIN OF THE HEX COORDINATE
```

```
0058    C     *                SYSTEM EXPRESSED AS A REAL-VALUED QUANTITY IN
0059    C     *                DEGREES.  (IN COMMON/HEX/)
0060    C     *       DIAM(NDIG)
0061    C     *               - ARRAY CONTAINING THE DIAMETER IN METERS OF A HEX
0062    C     *                 WHOSE ADDRESS CONTAINS NDIG HEX DIGITS.  (IN
0063    C     *                 COMMON/HEX/)
0064    C     *       DIAMTR  - DIAMETER IN METERS OF HEXES AT THE MINIMUM HEX
0065    C     *                 LEVEL.  (IN COMMON/HEX/)
0066    C     *       XOFI    - X COORDINATE OF THE VECTOR (I,J) = (1,0) AT THE
0067    C     *                 MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0068    C     *       YOFI    - Y COORDINATE OF THE VECTOR (I,J) = (1,0) AT THE
0069    C     *                 MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0070    C     *       XOFJ    - X COORDINATE OF THE VECTOR (I,J) = (0,1) AT THE
0071    C     *                 MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0072    C     *       YOFJ    - Y COORDINATE OF THE VECTOR (I,J) = (0,1) AT THE
0073    C     *                 MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0074    C     *       RIOFX   - REAL I COORDINATE AT THE MINIMUM HEX LEVEL OF THE
0075    C     *                 VECTOR (X,Y) = (1,0).  (IN COMMON/HEX/)
0076    C     *       RJOFX   - REAL J COORDINATE AT THE MINIMUM HEX LEVEL OF THE
0077    C     *                 VECTOR (X,Y) = (1,0).  (IN COMMON/HEX/)
0078    C     *       RIOFY   - REAL I COORDINATE AT THE MINIMUM HEX LEVEL OF THE
0079    C     *                 VECTOR (X,Y) = (0,1).  (IN COMMON/HEX/)
0080    C     *       RJOFY   - REAL J COORDINATE AT THE MINIMUM HEX LEVEL OF THE
0081    C     *                 VECTOR (X,Y) = (0,1).  (IN COMMON/HEX/)
0082    C     *       ICON(HDIG + (NDX-1)*7)
0083    C     *       JCON(HDIG + (NDX-1)*7)
0084    C     *               - ARRAYS CONTAINING THE I AND J CONTRIBUTIONS OF
0085    C     *                 EACH POSSIBLE HEX DIGIT (1-7) AT EACH POSSIBLE
0086    C     *                 DIGIT POSITION IN A HEX ADDRESS.  HDIG INDICATES
0087    C     *                 THE HEX DIGIT, AND NDX INDICATES ITS POSITION
0088    C     *                 COUNTING FROM THE RIGHT.  (IN COMMON/HEX/)
0089    C     *       IVAL(HDIG)
0090    C     *       JVAL(HDIG)
0091    C     *               - ARRAYS CONTAINING THE I AND J COORDINATES CORRE-
0092    C     *                 SPONDING TO EACH OF THE 7 SINGLE DIGIT HEX VEC-
0093    C     *                 TORS (1-7).  (IN COMMON/HEX/)
0094    C     *       IMAX(HDIG)
0095    C     *       JMAX(HDIG)
0096    C     *             - ARRAYS CONTAINING THE I AND J COORDINATES (AT THE
0097    C     *               MINIMUM HEX LEVEL) OF THE CENTERS OF EACH OF THE
0098    C     *               7 HEXES OF MAXIMUM LEVEL.  (IN COMMON/HEX/)
0099    C     *
0100    C     ***************************************************************
0101          INCLUDE 'HEX.CMN'
0102    1 ***************************************************************
0103    1 *       FOR DEFINITIONS OF VARIABLES SEE HXINIT.FOR           *
0104    1 ***************************************************************
0105    1       IMPLICIT INTEGER(H,P)
0106    1       COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMTR,
0107    1      +           XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0108    1      +           ICON(70),JCON(70),IMAX(7),JMAX(7)
0109    1 ***************************************************************
0110          DIMENSION IVAL(7),JVAL(7)
0111          EQUIVALENCE(IVAL(1),ICON(1)),(JVAL(1),JCON(1))
0112    C     *HEX ROTATIONAL CONSTANT IN DEGREES = ARCTAN(SQRT(3)/5)
0113          DATA RCON/19.10661/
0114    C     *DEGREES TO RADIANS CONVERSION CONSTANT
```

```
HXINIT

      DATA DG2RD/0.01745329/
C       *SET OUTPUT DEVICE NUMBER FOR HEX ERROR MESSAGES
        IHXOUT = IWRITE
C       *SET MAXIMUM NUMBER OF LEVELS TO MAXIMUM LEVEL PLUS ONE
        NHLEV = LEVMAX + 1
C       *SET MINIMUM LEVEL
        MINLEV = LEVMIN
C       *COMPUTE SINE AND COSINE OF LATITUDE OF ORIGIN
        RLT  = DLT * DG2RD
        SLTO = SIN(RLT)
        CLTO = COS(RLT)
C       *SET LONGITUDE OF ORIGIN
        OLNO = OLN
C       *DETERMINE NUMBER OF DIGITS IN MINIMUM LEVEL HEX ADDRESS
        NDIG = NHLEV - MINLEV
C       *COMPUTE DIAMETER OF HEX AT MINIMUM LEVEL
        SQRT7  = SQRT(7.0)
        DIAMTR = SIZHEX/(SQRT7**(LEVSIZ-MINLEV))
C       *INITIALIZE DIAMETER COMPUTATION LOOP AT MINIMUM HEX LEVEL
        NHD = NDIG
        SIZ = DIAMTR
C       *LOOP(FOR ALL HEX LEVELS)
 1100   CONTINUE
C         *SET DIAMETER OF HEX AT THIS LEVEL
          DIAM(NHD) = SIZ
C         *UPDATE NUMBER OF DIGITS AND DIAMETER FOR NEXT LEVEL
          NHD = NHD - 1
          SIZ = SIZ * SQRT7
C       *ENDLOOP(HEX LEVEL LOOP)
        IF(NHD.GT.0) GOTO 1100
C       *COMPUTE POLAR COORDINATE ANGLES OF I- AND J-AXES AT MIN LEVEL
        ROT8   = RCON * FLOAT(MINLEV)
        ANGLEI = (+90.0 + ROT8) * DG2RD
        ANGLEJ = (-30.0 + ROT8) * DG2RD
C       *COMPUTE X,Y COORDINATES OF UNIT I AND J VECTORS AT MIN LEVEL
        XOFI = COS(ANGLEI) * DIAMTR
        YOFI = SIN(ANGLEI) * DIAMTR
        XOFJ = COS(ANGLEJ) * DIAMTR
        YOFJ = SIN(ANGLEJ) * DIAMTR
C       *COMPUTE I,J COORDINATES AT MIN LEVEL OF UNIT X AND Y VECTORS
        DTERM = XOFI*YOFJ - XOFJ*YOFI
        RIOFX = +YOFJ/DTERM
        RJOFX = -YOFI/DTERM
        RIOFY = -XOFJ/DTERM
        RJOFY = +XOFI/DTERM
C       *LOOP(FOR ALL SINGLE DIGIT HEX VECTORS)
        DO 1200 HDIG = 1,7
C         *SET CORRESPONDING I AND J COORDINATES
          IPART = IAND(HDIG,1)
          JPART = IAND(ISHFT(HDIG,-1),1)
          KPART = ISHFT(HDIG,-2)
          IVAL(HDIG) = IPART - KPART
          JVAL(HDIG) = JPART - KPART
C       *ENDLOOP(SINGLE DIGIT HEX VECTOR LOOP)
 1200   CONTINUE
C       *INITIALIZE I AND J CONTRIBUTION COMPUTATION LOOP INDICES
        IXOLD = 0
```

HXINIT

```
0172                IXNEW = 7
0173                IXLIM = 7*MDIG
0174      C        *LOOP(FOR ALL POSSIBLE DIGIT POSITIONS PAST FIRST)
0175       1300     CONTINUE
0176      C           *LOOP(FOR ALL HEX DIGITS)
0177                   DO 1400 HDIG = 1,7
0178      C              *COMPUTE I AND J CONTRIBUTIONS FROM LAST POSITION VALUES
0179                      ICON(HDIG+IXNEW) = 2*ICON(HDIG+IXOLD) + JCON(HDIG+IXOLD)
0180                      JCON(HDIG+IXNEW) = 3*JCON(HDIG+IXOLD) - ICON(HDIG+IXOLD)
0181      C              *ENDLOOP(HEX DIGIT LOOP)
0182       1400           CONTINUE
0183      C              *UPDATE LOOP INDICES FOR NEXT DIGIT POSITION
0184                      IXOLD = IXNEW
0185                      IXNEW = IXOLD + 7
0186      C           *ENDLOOP(DIGIT POSITION LOOP)
0187                   IF(IXNEW.LT.IXLIM) GOTO 1300
0188      C           *LOOP(FOR ALL HEXES OF MAXIMUM LEVEL)
0189                   DO 1500 HDIG = 1,7
0190      C              *SET I AND J COORDINATES AT MINIMUM HEX LEVEL
0191                      IMAX(HDIG) = ICON(HDIG+IXOLD)
0192                      JMAX(HDIG) = JCON(HDIG+IXOLD)
0193      C           *ENDLOOP(HEXES OF MAXIMUM LEVEL LOOP)
0194       1500     CONTINUE
0195      C       *ENDROUTINE(HXINIT)
0196              RETURN
0197              END
```

```
0001          INTEGER FUNCTION HXINV(HEX)
0002      C   *ROUTINE(FIND HEX INVERSE OF AN OCTAL HEX NUMBER - HXINV)
0003      C   ************************************************************
0004      C   *
0005      C   *    DESIGNER/PROGRAMMER:
0006      C   *       DON KRECKER  12 SEPTEMBER 1980
0007      C   *    PURPOSE:
0008      C   *       HXINV COMPUTES THE INVERSE OF A HEX NUMBER EXPRESSED IN
0009      C   *       OCTAL REPRESENTATION.  THE ALGORITHM INVERTS ALL HEX DIGITS
0010      C   *       IN PARALLEL.  HEX DIGITS 1 THROUGH 6 ARE COMPLEMENTED MOD
0011      C   *       7, WHILE THE HEX DIGIT 7 REMAINS UNCHANGED.  OCTAL 0 DIGITS
0012      C   *       TO THE LEFT OF THE MOST SIGNIFICANT HEX DIGIT ALSO REMAIN
0013      C   *       UNCHANGED.  THE ALGORITHM USES SHIFT AND LOGICAL OPERATIONS
0014      C   *       TO FLAG THE DIGITS 1 THROUGH 6.  THEN THESE DIGITS ARE IN-
0015      C   *       VERTED WHILE THE 0 AND 7 DIGITS ARE UNTOUCHED.
0016      C   *    CALLING SEQUENCE:
0017      C   *       HXINV = HXINV(HEX)
0018      C   *    INPUT:
0019      C   *       HEX     - HEX NUMBER TO BE INVERTED
0020      C   *    OUTPUT:
0021      C   *       HXINV   - HEX INVERSE OF THE ARGUMENT HEX NUMBER
0022      C   *
0023      C   ************************************************************
0024.         IMPLICIT INTEGER(H,P)
0025      C   *MASK OF OCTAL 1 DIGITS
0026          DATA M1/'1111111111'O/
0027      C     *SET LOCAL VARIABLES TO HEX NUMBER SHIFTED 0, 1, AND 2 BITS
0028            HSHFT0 = HEX
0029            HSHFT1 = ISHFT(HEX,-1)
0030            HSHFT2 = ISHFT(HEX,-2)
0031      C     *FLAG DIGITS 1 THROUGH 6 IN LOW ORDER BIT POSITION OF DIGITS
0032            M1TO6 = IAND(IOR(IEOR(HSHFT0,HSHFT1),IEOR(HSHFT1,HSHFT2)),M1)
0033      C     *EXTEND FLAGS TO MASK ALL 3 BITS OF DIGITS 1 THROUGH 6
0034            M1TO6 = M1TO6 * 7
0035      C     *INVERT DIGITS 1 THROUGH 6 AND RETURN RESULT AS HEX INVERSE
0036            HXINV = IEOR(HEX,M1TO6)
0037      C   *ENDROUTINE(HXINV)
0038          RETURN
0039          END
```

```
0001          SUBROUTINE IGRID(X,Y,I,J)
0002     ************************************************************
0003     *       THIS ROUTINE CONVERTS THE UTM COORDINATES X,Y TO THE  *
0004     *       GRID INDICES I,J.                                     *
0005     *       THE ORIGIN IS 500,000 5,600,000 IN GRID ZONE 32U AND  *
0006     *       THE UNITS ARE 20 METERS. THE INDEX FOR THE ORIGIN IS  *
0007     *       IN RECORD (65,65) OUT OF 128*128 RECORDS.             *
0008     ************************************************************
0009          IMPLICIT INTEGER*4 (A-Z)
0010         I=((X-500000)/20+32500)/500
0011         J=((Y-5600000)/20+32500)/500
0012         RETURN
0013         END
```

```
0001              FUNCTION ICODE(I,J)
0002         ************************************************************
0003         *        EXTRACTS THE FEATURE CODE FROM IBUF(I,J)          *
0004         ************************************************************
0005         *        INPUTS: I,J; THE Y AND X INDICES,RESPECTIVELY     *
0006         *        OUTPUTS:  ICODE, THE SURFACE FEATURE CODE         *
0007         ************************************************************
0008              IMPLICIT INTEGER*2 (I-N)
0009              INCLUDE 'MAP.CMN'
0010    1    ************************************************************
0011    1    *        IBUF HOLDS A 40*40KM ARRAY OF DISPLAY DATA,WITH   *
0012    1    *        THE FIRST INDEX CORRESPONDS TO NORTHING, AND      *
0013    1    *        THE SECOND TO EASTING.                            *
0014    1    ************************************************************
0015    1         INTEGER*2 IBUF(400,400)
0016    1       COMMON /MAP/IBUF
0017    1    ************************************************************
0018              ICODE=IBUF(I,J)-IELV(I,J)*8
0019 C  D         CALL CMCLOS
0020 C  D         PRINT*,ICODE,IELV(I,J)
0021 C  D         CALL CMOPEN
0022              RETURN
0023              END
```

```
0001              FUNCTION IELV(I,J)
0002         ***************************************************************
0003         *        EXTRACTS THE ELEVATION  FROM IBUF(I,J)                *
0004         ***************************************************************
0005         *        INPUTS:  I,J; THE Y AND X COORDINATES,RESPECTIVELY    *
0006         *        OUTPUTS: IELV, THE ELEVATION OF THE POINT             *
0007         ***************************************************************
0008              1    IMPLICIT INTEGER*2 (I-N)
0009              1    INCLUDE 'MAP.CMN'
0010           1  ***************************************************************
0011           1  *        IBUF HOLDS A 40*40KM ARRAY OF DISPLAY DATA,WITH      *
0012           1  *        THE FIRST INDEX CORRESPONDS TO NORTHING, AND         *
0013           1  *        THE SECOND TO EASTING.                               *
0014           1  ***************************************************************
0015           1        INTEGER*2 IBUF(400,400)
0016           1      COMMON /MAP/IBUF
0017           1  ***************************************************************
0018         C  D        PRINT*,'IELV',I,J
0019                     IELV=IBUF(I,J)/8
0020                     RETURN
0021                     END
```

```
0001            INTEGER FUNCTION IJL2HA(I,J,LEVIJ)
0002      C     *ROUTINE(CONVERT I,J, AND LEVEL TO EQUIVALENT HEX ADDRESS-IJL2HA)
0003      C     ************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  18 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       IJL2HA CONVERTS A GIVEN I,J, AND LEVEL TRIPLE TO AN EQUI-
0009      C     *       VALENT HEX ADDRESS IN OCTAL REPRESENTATION.  I AND J ARE
0010      C     *       OBLIQUE COORDINATES EXPRESSED IN UNITS CORRESPONDING TO
0011      C     *       HEX DIAMETERS AT THE GIVEN LEVEL OF HEX AGGREGATION, AND
0012      C     *       THE COMPUTED HEX ADDRESS WILL BE AT THIS SAME LEVEL.
0013      C     *       IJL2HA IS THE INVERSE OF THE SUBROUTINE HA2IJL WHICH COM-
0014      C     *       PUTES THE I,J, AND LEVEL TRIPLE CORRESPONDING TO A GIVEN
0015      C     *       HEX ADDRESS.
0016      C     *       AFTER CHECKING THE VALIDITY OF THE REQUESTED HEX LEVEL,
0017      C     *       THE ALGORITHM CONSTRUCTS THE HEX ADDRESS AT THAT LEVEL
0018      C     *       CENTERED AT THE ORIGIN.  THIS IS A STRING OF (NHLEV-LEVEL)
0019      C     *       HEX DIGITS, EACH EQUAL TO 7, WHERE NHLEV IS THE MAXIMUM
0020      C     *       NUMBER OF LEVELS OF HEX AGGREGATION.  THEN, WORKING FROM
0021      C     *       RIGHT TO LEFT, SUCCESSIVE HEX DIGITS ARE EXTRACTED FROM
0022      C     *       THE I,J COORDINATES AND INSERTED IN PLACE OF 7S IN THE
0023      C     *       HEX ADDRESS.  THE HEX DIGITS ARE COMPUTED AS DESCRIBED IN
0024      C     *       THE ROUTINE IJ2HV.
0025      C     *    CALLING SEQUENCE:
0026      C     *       IJL2HA = IJL2HA(I,J,LEVIJ)
0027      C     *    INPUT:
0028      C     *       I,J     - INTEGER-VALUED OBLIQUE COORDINATES WHICH ARE TO
0029      C     *                 BE CONVERTED TO AN EQUIVALENT HEX ADDRESS AT THE
0030      C     *                 SPECIFIED LEVEL OF HEX AGGREGATION
0031      C     *       LEVIJ   - LEVEL OF HEX AGGREGATION WITH RESPECT TO WHICH
0032      C     *                 THE I,J COORDINATES ARE EXPRESSED AND AT WHICH
0033      C     *                 THE HEX ADDRESS IS TO BE COMPUTED
0034      C     *       NHLEV   - MAXIMUM NUMBER OF LEVELS OF HEX AGGREGATION.
0035      C     *                 (IN COMMON/HEX/)
0036      C     *       MINLEV - MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0037      C     *       IVAL(HDIG)
0038      C     *       JVAL(HDIG)
0039      C     *                - ARRAYS CONTAINING THE I,J COORDINATES CORRESPON-
0040      C     *                  DING TO EACH OF THE 7 SINGLE DIGIT HEX VECTORS
0041      C     *                  (1-7).  FOR EXAMPLE, SINCE THE HEX VECTOR 1 COR-
0042      C     *                  RESPONDS TO (I,J) = (1,0), IVAL(1) = 1 AND
0043      C     *                  JVAL(1) = 0.  (IN COMMON/HEX/)
0044      C     *    OUTPUT:
0045      C     *       IJL2HA - HEX ADDRESS CORRESPONDING TO THE GIVEN I,J OBLIQUE
0046      C     *                COORDINATES AT THE SPECIFIED LEVEL OF AGGREGATION
0047      C     *
0048      C     ************************************************************
0049                  INCLUDE 'HEX.CMN'
0050      1 ************************************************************
0051      1 *       FOR DEFINITIONS OF VARIABLES SEE HXINIT.FOR                *
0052      1 ************************************************************
0053      1       IMPLICIT INTEGER(H,P)
0054      1       COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMIR,
0055      1      +           XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0056      1      +           ICON(70),JCON(70),IMAX(7),JMAX(7)
0057      1 ************************************************************
```

IJL2HA

```
0058            DIMENSION IVAL(7),JVAL(7)
0059            EQUIVALENCE(IVAL(1),ICON(1)),(JVAL(1),JCON(1))
0060      C       *IF(VALID HEX LEVEL)THEN
0061               IF(LEVIJ.LT.MINLEV) GOTO 1200
0062               IF(LEVIJ.GE.NHLEV)  GOTO 1200
0063      C          *CONSTRUCT HEX ADDRESS AT GIVEN LEVEL CENTERED AT ORIGIN
0064                 HADR = ISHFT(1,3*(NHLEV-LEVIJ)) - 1
0065      C          *INITIALIZE HEX DIGIT EXTRACTION LOOP
0066                 ILOCAL = I
0067                 JLOCAL = J
0068                 HSHIFT = 0
0069      C          *LOOP UNTIL(NO MORE HEX DIGITS TO EXTRACT FROM (I,J))
0070       1100      CONTINUE
0071      C             *COMPUTE NEXT HEX DIGIT = (I + 2*J) MOD 7
0072                    HDIG = ILOCAL + JLOCAL + JLOCAL
0073                    HDIG = HDIG - (HDIG/7)*7
0074                    IF(HDIG.LE.0) HDIG = HDIG + 7
0075      C             *INSERT HEX DIGIT AT FRONT OF HEX ADDRESS
0076                    HADR   = HADR - ISHFT(7-HDIG,HSHIFT)
0077                    HSHIFT = HSHIFT + 3
0078      C             *SUBTRACT (I,J) CORRESPONDING TO NEWLY FOUND HEX DIGIT
0079                    INEW = ILOCAL - IVAL(HDIG)
0080                    JNEW = JLOCAL - JVAL(HDIG)
0081      C             *SHRINK NEW I,J VECTOR TO NEXT LOWER HEX LEVEL
0082                    ILOCAL = (3*INEW - JNEW)/7
0083                    JLOCAL = (INEW + JNEW + JNEW)/7
0084      C          *ENDLOOP(HEX DIGIT EXTRACTION LOOP)
0085                  IF(ILOCAL.NE.0) GOTO 1100
0086                  IF(JLOCAL.NE.0) GOTO 1100
0087      C           *RETURN COMPUTED HEX ADDRESS
0088                   IJL2HA = HADR
0089      C        *ELSE(INVALID HEX LEVEL)
0090               GOTO 1300
0091       1200    CONTINUE
0092      C           *SET RETURN HEX ADDRESS TO ZERO
0093                   IJL2HA = 0
0094      C           *INCLUDE(GENERATE HEX ERROR MESSAGE - HXERR)
0095                   CALL HXERR(6HIJL2HA,3,LEVIJ,0,0,0)
0096      C        *ENDIF(HEX LEVEL CHECK)
0097       1300    CONTINUE
0098      C     *ENDROUTINE(IJL2HA)
0099            RETURN
0100            END
```

```
0058     C           *SET RETURN HEX ADDRESS TO ZERO
0059                  IJM2HA = 0
0060     C           *INCLUDE(GENERATE HEX ERROR MESSAGE - HXERR)
0061                  CALL HXERR(6HIJM2HA,3,LEV,0,0,0)
0062     C         *ENDIF(HEX LEVEL CHECK)
0063       1200     CONTINUE
0064     C      *ENDROUTINE(IJM2HA)
0065            RETURN
0066            END
```

```
0001            INTEGER FUNCTION IJM2HA(I,J,LEV)
0002      C     *ROUTINE(CONVERT MIN LEVEL I,J COORDINATES TO HEX ADDRESS-IJ42HA)
0003      C     ***************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  20 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       IJM2HA TAKES A POINT EXPRESSED IN I,J OBLIQUE COORDINATES
0009      C     *       AT THE MINIMUM HEX LEVEL AND COMPUTES THE ADDRESS OF THE
0010      C     *       HEX AT THE SPECIFIED LEVEL WHICH CONTAINS THE POINT.  THE
0011      C     *       HEX ADDRESS IS COMPUTED IN OCTAL REPRESENTATION.  IF THE
0012      C     *       SPECIFIED HEX LEVEL IS GREATER THAN THE MINIMUM HEX LEVEL,
0013      C     *       THE COMPUTED HEX MAY DIFFER FROM THE HEX (AT THIS LEVEL)
0014      C     *       WHOSE CENTER IS CLOSEST TO THE GIVEN POINT.  THE REASON IS
0015      C     *       THAT HEXES AT HIGHER LEVELS OF AGGREGATION ARE NOT TRUE
0016      C     *       REGULAR HEXAGONS BUT ONLY APPROXIMATE REGULAR HEXAGONS IN
0017      C     *       SHAPE.  IJM2HA IS THE INVERSE OF THE SUBROUTINE HA2IJM,
0018      C     *       WHICH CONVERTS A HEX ADDRESS TO I,J COORDINATES AT THE
0019      C     *       MINIMUM HEX LEVEL.
0020      C     *       AFTER CHECKING THE VALIDITY OF THE REQUESTED HEX LEVEL,
0021      C     *       IJM2HA USES IJL2HA TO COMPUTE THE MINIMUM LEVEL HEX ADDRESS
0022      C     *       WITH THE GIVEN I,J COORDINATES.  THEN THE ADDRESS OF THE
0023      C     *       HEX AT THE SPECIFIED LEVEL IS FOUND BY TRUNCATING THE AP-
0024      C     *       PROPRIATE NUMBER OF HEX DIGITS.
0025      C     *    CALLING SEQUENCE:
0026      C     *       IJM2HA = IJM2HA(I,J,LEV)
0027      C     *    INPUT:
0028      C     *       I,J     - INTEGER-VALUED OBLIQUE COORDINATES AT THE MINIMUM
0029      C     *                 HEX LEVEL OF A POINT WHOSE CONTAINING HEX AT A
0030      C     *                 SPECIFIED LEVEL IS TO BE COMPUTED
0031      C     *       LEV     - LEVEL OF AGGREGATION OF THE HEX ADDRESS TO BE
0032      C     *                 COMPUTED
0033      C     *       NHLEV   - MAXIMUM NUMBER OF LEVELS OF HEX AGGREGATION.
0034      C     *                 (IN COMMON/HEX/)
0035      C     *       MINLEV  - MINIMUM HEX LEVEL.  (IN COMMON/HEX/)
0036      C     *    OUTPUT:
0037      C     *       IJM2HA  - ADDRESS OF THE HEX AT THE REQUESTED LEVEL WHICH
0038      C     *                 CONTAINS THE GIVEN I,J POINT
0039      C     *
0040      C     ***************************************************************
0041            IMPLICIT INTEGER(H,P)
0042            COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMI
0043           $R,
0044           +           XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0045           +           ICON(70),JCON(70),IMAX(7),JMAX(7)
0046            DIMENSION IVAL(7),JVAL(7)
0047            EQUIVALENCE(IVAL(1),ICON(1)),(JVAL(1),JCON(1))
0048      C       *IF(VALID HEX LEVEL)THEN
0049              IF(LEV.LT.MINLEV) GOTO 1100
0050              IF(LEV.GE.NHLEV)  GOTO 1100
0051      C         *CONVERT I,J COORDINATES TO MINIMUM LEVEL HEX ADDRESS
0052                HADR = IJL2HA(I,J,MINLEV)
0053      C         *TRUNCATE HEX DIGITS TO GET HEX ADDRESS AT REQUIRED LEVEL
0054                IJM2HA = ISHFT(HADR,3*(MINLEV-LEV))
0055      C       *ELSE(INVALID HEX LEVEL)
0056              GOTO 1200
0057       1100   CONTINUE
```

```
0001            SUBROUTINE IJM2XY(I,J,X,Y)
0002      C     *ROUTINE(CONVERT MIN LEVEL I,J TO X,Y COORDINATES - IJ42XY)
0003      C     ************************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  20 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       IJM2XY CONVERTS A PAIR OF I,J OBLIQUE COORDINATES AT THE
0009      C     *       MINIMUM HEX LEVEL TO THE EQUIVALENT X,Y CARTESIAN COORDI-
0010      C     *       NATES IN METERS.  THIS ROUTINE IS THE INVERSE OF THE SUB-
0011      C     *       ROUTINE XY2IJM.
0012      C     *       THE CONVERSION IS EFFECTED BY APPLYING A LINEAR TRANSFOR-
0013      C     *       MATION (IN THE FORM OF A MATRIX MULTIPLICATION) TO THE
0014      C     *       I,J VECTOR TO OBTAIN AN X,Y VECTOR.
0015      C     *    CALLING SEQUENCE:
0016      C     *       CALL IJM2XY(I,J,X,Y)
0017      C     *    INPUT:
0018      C     *       I,J     - INTEGER-VALUED OBLIQUE COORDINATES EXPRESSED IN
0019      C     *                 HEX DIAMETERS AT THE MINIMUM HEX LEVEL WHICH ARE
0020      C     *                 TO BE CONVERTED TO CARTESIAN COORDINATES
0021      C     *       XOFI    - X COORDINATE OF THE VECTOR (I,J) = (1,0).
0022      C     *                 (IN COMMON/HEX/)
0023      C     *       YOFI    - Y COORDINATE OF THE VECTOR (I,J) = (1,0).
0024      C     *                 (IN COMMON/HEX/)
0025      C     *       XOFJ    - X COORDINATE OF THE VECTOR (I,J) = (0,1).
0026      C     *                 (IN COMMON/HEX/)
0027      C     *       YOFJ    - Y COORDINATE OF THE VECTOR (I,J) = (0,1).
0028      C     *                 (IN COMMON/HEX/)
0029      C     *    OUTPUT:
0030      C     *       X,Y     - REAL-VALUED CARTESIAN COORDINATES EXPRESSED IN
0031      C     *                 METERS EQUIVALENT TO THE GIVEN OBLIQUE COORDINATES
0032      C     *
0033      C     ************************************************************************
0034            IMPLICIT INTEGER(H,P)
0035            COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,DLNO,DIAM(10),DIAMI
0036           SR,
0037           +                 XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0038           +                 ICON(70),JCON(70),IMAX(7),JMAX(7)
0039            DIMENSION IVAL(7),JVAL(7)
0040            EQUIVALENCE(IVAL(1),ICON(1)),(JVAL(1),JCON(1))
0041      C       *CONVERT INTEGER-VALUED I,J COORDINATES TO REAL
0042              RI = FLOAT(I)
0043              RJ = FLOAT(J)
0044      C       *TRANSFORM TO EQUIVALENT X,Y COORDINATES IN METERS
0045              X = XOFI * RI + XOFJ * RJ
0046              Y = YOFI * RI + YOFJ * RJ
0047      C     *ENDROUTINE(IJM2XY)
0048            RETURN
0049            END
```

```
0001            SUBROUTINE LABEL
0002      ************************************************************
0003      *       THIS SUBROUTINE LABELS THE COLOR CODES USED IN     *
0004      *       THE MAPPED-SECTION DISPLAY FILE.                   *
0005      ************************************************************
0006            REAL LEFT
0007            INTEGER*4 LABELS(7,2)
0008            DATA LABELS/'FORE','URBA','MARS','NULL','WATE','HEAT',
0009           +  'OPEN','SI','N','H',' ','R','H',' '/
0010            INCLUDE 'WINDO.CMN'
0011    1 ************************************************************
0012    1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND  *
0013    1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER   *
0014    1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS *
0015    1 *       THE CONTOUR INTERVAL.                                *
0016    1 ************************************************************
0017    1       DIMENSION FWINXY(4)
0018    1       COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0019    1 ************************************************************
0020            CALL CMOPEN
0021            CALL VWPORT(0.,40.,0.,90.)
0022            CALL WINDOW(0.,40.,0.,90.)
0023            CALL TXTCLR(4)
0024            CALL TXAM
0025            CALL TXSIZE(0,2.,2.)
0026            LEFT=5.
0027            RIGHT=15.
0028            DO I=1,7
0029               BOTTOM=10.*I
0030               TOP=BOTTOM+8.
0031               CALL LINCLR(I)
0032               DO X=LEFT,RIGHT,.5
0033                  CALL MOVE(X,BOTTOM)
0034                  CALL DRAW(X,TOP)
0035               ENDDO
0036                  CALL MOVE(X,BOTTOM+5.)
0037                  CALL TEXT(4,LABELS(I,1))
0038                  CALL TEXT(2,LABELS(I,2))
0039                  CALL MOVE(X,BOTTOM+2.)
0040                  CALL TEXT(5,'CODE:')
0041                  CALL INUMBR(I,1)
0042            ENDDO
0043            FX=FWINXY(1)
0044            FY=FWINXY(3)
0045            CALL MOVE(20.,6.)
0046            CALL RNUMBR(FX,-1,8)
0047            CALL MOVE(20.,0.)
0048            CALL RNUMBR(FY,-1,8)
0049            R=1.
0050            T=1.
0051            R=R*98.8+40.5
0052            T=T*98.8+.5
0053             CALL VWPORT(40.,R,0.,T)
0054            CALL WINDOW(FWINXY(1),FWINXY(2),FWINXY(3),FWINXY(4))
0055            CALL CMCLOS
0056            RETURN
0057            END
```

```
0001          SUBROUTINE INTERS(IX1,IY1,IX2,IY2,HEIGHT,FRAC,ICROSS)
0002     ************************************************************************
0003     *       FINDS INTERSECTION OF SEGMENT X1,Y1 TO X2,Y2 WITH HEIGHT       *
0004     ************************************************************************
0005     *       INPUTS:                                                        *
0006     *              IX1,IY1,IX2,IY2-- INDICES TO 2 POINTS IN THE DATA ARRAY *
0007     *              HEIGHT-- ELEVATION OF THE CONTOUR BEING TRACED          *
0008     *       OUTPUTS: FRAC -- FRACTION OF DISTANCE FROM POINT1 TOWARDS POINT2*
0009     *       ***  H. JONES ***                                              *
0010     ************************************************************************
0011          IMPLICIT INTEGER*2 (I-N)
0012     C
0013     C    *CHECK FOR NO INTERSECTION
0014          ICROSS = 0
0015          Z1=IELV(IY1,IX1)
0016          Z2=IELV(IY2,IX2)
0017          IF(Z1 .GE. HEIGHT  .AND. Z2 .GE. HEIGHT) THEN
0018             GO TO 10
0019          ENDIF
0020          IF(Z1 .LE. HEIGHT  .AND. Z2 .LE. HEIGHT) THEN
0021             GO TO 10
0022          ENDIF
0023     C
0024     C    *COMPUTE INTERSECTION
0025          ICROSS = 1
0026          FRAC = (HEIGHT -Z1) / (Z2-Z1)
0027     C
0028        10 RETURN
0029          END
```

```
0001            SUBROUTINE MAP2LL(FNAME,FLON,FLAT)
0002      ************************************************
0003      *       THIS ROUTINE COMPUTES THE LAT,LON OF THE *
0004      *       CENTER OF A SHEET FROM THE M745 SERIES.  *
0005      ************************************************
0006      *       INPUTS: FNAME-- THE NAME OF THE MAP      *
0007      *       OUTPUTS: FLON,FLAT-- REAL-VALUED LAT AND *
0008      *                LON OF THE CENTER OF THE MAP    *
0009      ************************************************
0010            CHARACTER*5 FNAME
0011            DIMENSION D(2)
0012            PARAMETER PI=3.141592654
0013            P_RAD=PI/180.
0014
0015            DO I=2,4,2
0016               DECODE(2,10,FNAME(I:I+1)) D(I/2)
0017            ENDDO
0018      10    FORMAT(F3.0)
0019
0020            DLAT=50+(59-D(1))/2.*.2+.1
0021            DLON=9+(D(2)-20)/2./3.+1./6.
0022            FLAT=DLAT*P_RAD
0023            FLON=DLON*P_RAD
0024            RETURN
0025            END
```

```
0001            SUBROUTINE MAP2UTM(FNAME,FEAST,FNORTH,CMERID)
0002      ***************************************************************
0003      *****  THIS ROUTINE COMPUTES THE UTM CENTER OF A SHEET FROM
0004      *****  THE M745 SERIES.
0005      ***************************************************************
0006            CHARACTER*5 FNAME
0007            DIMENSION D(2)
0008            PARAMETER PI=3.141592654
0009            P_RAD=PI/180.
0010
0011            DO I=2,4,2
0012               DECODE(2,10,FNAME(1:I+1)) D(I/2)
0013            ENDDO
0014      10    FORMAT(F3.0)
0015
0016            DLAT=50+(59-D(1))/2.*.2+.1
0017            DLON=9+(D(2)-20)/2./3.+1./6.
0018            FLAT=DLAT*P_RAD
0019            FLON=DLON*P_RAD
0020            CALL ADSMP(FLAT,FLON,CMERID,FEAST,FNORTH)
0021            FEAST=FEAST+500000.
0022            RETURN
0023            END
```

```
0001            SUBROUTINE MAPPER
0002      ************************************************************
0003      *       CALLS THE ROUTINES TO DISPLAY THE TERRAIN DATA      *
0004      ************************************************************
0005      *       INPUTS:  NONE                                       *
0006      *       OUTPUTS: NONE                                       *
0007      ************************************************************
0008            IMPLICIT INTEGER*2 (I-N)
0009            INCLUDE 'WINDO.CMN'
0010    1 ************************************************************
0011    1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND  *
0012    1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER   *
0013    1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS *
0014    1 *       THE CONTOUR INTERVAL.                                *
0015    1 ************************************************************
0016    1       DIMENSION FWINXY(4)
0017    1       COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0018    1 ************************************************************
0019            INCLUDE 'MAP.CMN'
0020    1 ************************************************************
0021    1 *       IBUF HOLDS A 40*40KM ARRAY OF DISPLAY DATA,WITH     *
0022    1 *       THE FIRST INDEX CORRESPONDS TO NORTHING, AND        *
0023    1 *       THE SECOND TO EASTING.                              *
0024    1 ************************************************************
0025    1       INTEGER*2 IBUF(400,400)
0026    1      COMMON /MAP/IBUF
0027    1 ************************************************************
0028            INCLUDE 'ANSWER.CMN'
0029    1 ************************************************
0030    1       CHARACTER*1 FEA,CON
0031    1       COMMON/ANSWER/FEA,CON
0032    1 ************************************************
0033            CALL CMOPEN
0034            CALL NEWPAG
0035
0036            IF(FEA.EQ.'Y')THEN
0037              CALL LABEL
0038              INCR=2
0039              CALL FEATURES(INCR)
0040            ENDIF
0041            IF(CON.EQ.'Y')THEN
0042              CALL MAXMIN
0043              DBRES=100
0044              ZMIN=MIN
0045              ZMAX=MAX
0046              CONRES=400. ! CHECK ELEVATION EVERY 400 M
0047              IF(MAX.GT.-32767.AND.MIN.LT.32767)THEN
0048               CALL CMOPEN
0049               CALL LINCLR(4)
0050               CALL VWPORT(40.,139.3,0.,99.3)
0051               CALL WINDOW(0.,40000.,0.,40000.)
0052               CALL DRWCON(FWINXY,DBRES,CONRES,ZMIN,ZMAX,ZDELT)
0053              ELSE
0054                CALL CMCLOS
0055                PRINT*,'NO DATA IN THIS AREA.'
0056              ENDIF
0057            ENDIF
```

```
0058     30       CONTINUE
0059              CALL WINDOW(FWINXY(1),FWINXY(2),FWINXY(3),FWINXY(4))
0060              CALL GRIDS
0061              CALL CMCLOS
0062              RETURN
0063              END
```

```
0001            SUBROUTINE MAPIN(IR,JC,MGR,ERR)
0002      ************************************************************
0003      *       READS IN A 10KM FILE AND PLACES IT IN THE BUFFER, IBUF   *
0004      ************************************************************
0005      *       INPUTS:                                                  *
0006      *               IR,JC-- THE 'ROW' AND 'COLUMN' OF THE FILE,      *
0007      *                       EACH RUNS FROM 0 TO 3                    *
0008      *               MGR-- THE MILITARY GRID REFERENCE (UTM) NAME OF  *
0009      *                     THE FILE TO BE OPENED                      *
0010      *       OUTPUTS: ERR-- AN ERROR FLAG                             *
0011      ************************************************************
0012            LOGICAL*1 ERR
0013            CHARACTER*7 MGR
0014            INTEGER*2 ROW,COL
0015            INCLUDE 'CORNER.CMN'
0016     1 ************************************************************
0017     1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE  *
0018     1 *       AREA IN THE ARRAY IBUF.                           *
0019     1       INTEGER*4 SWX,SWY
0020     1       COMMON/CORNER/SWX,SWY
0021     1 ************************************************************
0022            INCLUDE 'MAP.CMN'
0023     1 ************************************************************
0024     1 *       IBUF HOLDS A 40*40KM ARRAY OF DISPLAY DATA,WITH   *
0025     1 *       THE FIRST INDEX CORRESPONDS TO NORTHING, AND      *
0026     1 *       THE SECOND TO EASTING.                            *
0027     1 ************************************************************
0028     1       INTEGER*2 IBUF(400,400)
0029     1      COMMON /MAP/IBUF
0030     1 ************************************************************
0031            INTEGER*2 SQUARE(100,100)
0032            OPEN(UNIT=9,NAME=MGR,STATUS='OLD',FORM='UNFORMATTED',ERR=10)
0033            READ(9)SQUARE
0034
0035      20    CONTINUE
0036            IROW=100*IR
0037            JCOL=100*JC
0038              DO J=1,100
0039              COL=JCOL+J
0040                DO I=1,100
0041                ROW=IROW+I
0042                IBUF(ROW,COL)=SQUARE(I,J)
0043                ENDDO
0044              ENDDO
0045            CLOSE(UNIT=9)
0046            RETURN
0047      10    ERR=.TRUE.
0048            PRINT*,'NO FILE: ',MGR
0049            DO I=1,100
0050               DO J=1,100
0051                  SQUARE(I,J)=0
0052               ENDDO
0053            ENDDO
0054            GOTO20
0055            END
```

```
0001            SUBROUTINE MAPOUT(IR,JC,MGR,ERR)
0002      ************************************************************************
0003      *       REWRITES THE 10KM FILES.                                       *
0004      ************************************************************************
0005      *       INPUTS:                                                        *
0006      *               IR,JC--THE 'ROW' AND 'COLUMN' OF THE 100*100 ARRAY TO  *
0007      *                      BE WRITTEN;  THE VALUES RUN FROM 0 TO 3         *
0008      *               MGR--  THE NAME OF THE FILE                            *
0009      *       OUTPUTS:  ERR-- AN ERROR FLAG                                  *
0010      ************************************************************************
0011            LOGICAL*1 ERR
0012            CHARACTER*7 MGR
0013            INTEGER*2 ROW,COL
0014            INCLUDE 'CORNER.CMN'
0015     1 ***************************************************************
0016     1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE      *
0017     1 *       AREA IN THE ARRAY IBUF.                               *
0018     1       INTEGER*4 SWX,SWY
0019     1       COMMON/CORNER/SWX,SWY
0020     1 ***************************************************************
0021            INCLUDE 'MAP.CMN'
0022     1 ***************************************************************
0023     1 *       IBUF HOLDS A 40*40KM ARRAY OF DISPLAY DATA,WITH       *
0024     1 *       THE FIRST INDEX CORRESPONDS TO NORTHING, AND          *
0025     1 *       THE SECOND TO EASTING.                                *
0026     1 ***************************************************************
0027     1       INTEGER*2 IBUF(400,400)
0028     1      COMMON /MAP/IBUF
0029     1 ***************************************************************
0030            INTEGER*2 SQUARE(100,100)
0031            OPEN(UNIT=9,NAME=MGR,STATUS='UNKNOWN',FORM='UNFORMATTED',ERR=10)
0032
0033            IROW=100*IR
0034            JCOL=100*JC
0035              DO J=1,100
0036              COL=JCOL+J
0037                DO I=1,100
0038                ROW=IROW+I
0039                SQUARE(I,J)=IBUF(ROW,COL)
0040                ENDDO
0041              ENDDO
0042            WRITE(9)SQUARE
0043            CLOSE(UNIT=9)
0044            RETURN
0045     10     ERR=.TRUE.
0046            PRINT*,'ERROR ON OPENING FILE ',MGR
0047            RETURN
0048            END
```

```
0001            SUBROUTINE MAXMIN
0002      ************************************************************
0003      *       FINDS THE MAX AND MIN ELEVATION VALUES IN THE      *
0004      *       DATA ARRAY.                                        *
0005      ************************************************************
0006            IMPLICIT INTEGER*2 (I-N)
0007            CHARACTER*14 NAMEF
0008              INCLUDE 'WINDO.CMN'
0009    1 ************************************************************
0010    1 *       FWINXY CONTAINS THE X MIN AND MAX AND THE Y MIN AND  *
0011    1 *       MAX RESPECTIVELY FOR THE WINDOW. MIN AND MAX REFER   *
0012    1 *       TO THE MIN AND MAX OF ELEVATION VALUES, AND ZDELT IS *
0013    1 *       THE CONTOUR INTERVAL.                                *
0014    1 ************************************************************
0015    1         DIMENSION FWINXY(4)
0016    1         COMMON/WINDO/FWINXY,MIN,MAX,ZDELT
0017    1 ************************************************************
0018              INCLUDE 'MAP.CMN'
0019    1 ************************************************************
0020    1 *       IBUF HOLDS A 40*40KM ARRAY OF DISPLAY DATA,WITH    *
0021    1 *       THE FIRST INDEX CORRESPONDS TO NORTHING, AND       *
0022    1 *       THE SECOND TO EASTING.                             *
0023    1 ************************************************************
0024    1         INTEGER*2 IBUF(400,400)
0025    1       COMMON /MAP/IBUF
0026    1 ************************************************************
0027              MIN=32767
0028              MAX=-32767
0029              X1=1
0030              X2=400
0031              Y3=1
0032              Y4=400
0033      C       IN THE INTEREST OF TIME,ONLY EVERY FOURTH POINT IS CHECKED
0034              X=4.
0035              Y=4.
0036              DO J=X1,X2,X
0037                DO I=Y3,Y4,Y
0038                  IMIN=MIN0(IELV(I,J),MIN)
0039                  MAX=MAX0(IELV(I,J),MAX)
0040                  IF(IMIN.GT.0)THEN
0041                   MIN=IMIN
0042                  ENDIF
0043                ENDDO
0044              ENDDO
0045              RETURN
0046            END
```

```
0001            SUBROUTINE OPENERS
0002      ************************************************************
0003      *       THIS ROUTINE SIMPLY OPENS THE GRID,NODE,LINK,AND   *
0004      *       SUBNODE FILES, AND THE ISAM FILE WHICH CONTAINS    *
0005      *       THE 'HEXISED' LOC OR HYDRO DATA                    *
0006      ************************************************************
0007              OPEN(UNIT=1,NAME='GRID',TYPE='OLD',READONLY,SHARED,
0008           *ACCESS='DIRECT',BLOCKSIZE=2000)
0009              OPEN(UNIT=2,NAME='NODE',TYPE='OLD',READONLY,SHARED,
0010           *ACCESS='DIRECT',BLOCKSIZE=2000)
0011              OPEN(UNIT=3,NAME='ROAD',TYPE='OLD',READONLY,SHARED,
0012           *ACCESS='DIRECT',BLOCKSIZE=2000)
0013              OPEN(UNIT=4,NAME='SUBN',TYPE='OLD',READONLY,SHARED,
0014           *ACCESS='DIRECT',BLOCKSIZE=2000)
0015      *
0016      *       NOW FOR THE ISAM FILE
0017              OPEN(UNIT=7,NAME='HEXROAD',STATUS='UNKNOWN',
0018           +  ORGANIZATION='INDEXED',ACCESS='KEYED',RECL=2,
0019           +  RECORDTYPE='FIXED',FORM='UNFORMATTED',
0020           +  KEY=(1:4:INTEGER))
0021              RETURN
0022              END
```

```
0001            SUBROUTINE PACKER(HEX,HSIDE,IADJ,LU)
0002     C*************************************************************
0003     C****  THIS PACKS THE MAX VALUE OF CONNECTIVITY 'TYPE'
0004     C****  AT 'SIDE' OF THE HEX INTO THE APPROPRIATE DIGIT
0005     C****  OF 'SIDES'
0006     C*************************************************************
0007     C*****  INPUT:
0008     C*****          HEX--INTERNAL HEX#
0009     C*****          HSIDE-- HEX SIDE CURRENTLY BEING PROCESSED
0010     C*****          IADJ-- ERROR FLAG DENOTING THAT THE DIFFERENCE
0011     C*****                 IN THE TWO HEXES WAS TOO LARGE
0012     C*****  OUTPUT:
0013     C*****          HEX
0014     C*****          HSIDE
0015     C*****          SIDE-- DECIMAL NUMBER OF THE SIDE;RANGE:1-6
0016     C*****          SIDES-- THE PACKED CONNECTIVITIES OF THE HEX
0017     C*************************************************************
0018     C
0019            IMPLICIT INTEGER (H,P)
0020            INTEGER*4 TOP,TMP,BOTTOM,SID9,SID10,SIDE,HSIDE
0021            INCLUDE 'PACKER.CMN'
0022   1 ***************************************************************
0023   1        INTEGER*4 SIDES ! PACKED CONNECTIVITIES                 *
0024   1        INTEGER*4 LITYPE ! CONNECTIVITY FOR CURRENT SIDE        *
0025   1        COMMON/PACK/SIDES,LITYPE
0026   1 ***************************************************************
0027 C  D       PRINT*,'LU IN PACKER',LU
0028     C
0029     C*****  IADJ=1 IF THE HEXES WERE ADJACENT;IE IF THEIR
0030     C*****  VECTOR DIFFERENCE IS FROM 1 TO 6, AND 0 IF NOT
0031            IADJ=1
0032            CALL STRIPPER(HSIDE,SIDE)
0033            IF(SIDE.LE.0)THEN
0034               IADJ=0
0035               RETURN
0036            ENDIF
0037            SID9=10**(SIDE-1)
0038            SID10=10**SIDE
0039     C
0040     C      STRIP OFF THE UPPER DIGITS
0041            TOP=INT(SIDES/SID10)*SID10
0042     C
0043     C      NOW GET THE LOWER ONES
0044            TMP=SIDES-TOP
0045            ISIDE=INT(TMP/SID9)
0046            BOTTOM=TMP-ISIDE*SID9
0047     C
0048     C      RESET THE VALUE FOR THE CONNECTIVITY
0049            ITYPE=MAX(ISIDE,LTYPE)
0050     C
0051     C      REPACK
0052            SIDES=TOP+ITYPE*SID9+BOTTOM
0053            CALL HEXWRITE(HEX,SIDES,LU)
0054            RETURN
0055            END
```

```
0001            SUBROUTINE REPACK(HSTOR,LTYPE)
0002      ************************************************************
0003      *       REPACKS THE CONNECTIVITY OR HYDRO LEVELS FOR A HEX   *
0004      ************************************************************
0005      *       INPUTS: HSTOR-- INTERNAL HEX NUMBER                  *
0006      *                 LTYPE-- LOC OR HYDRO LEVEL AT THE GIVEN SIDE *
0007      ************************************************************
0008            IMPLICIT INTEGER(A,P)
0009            INTEGER*4 SIDES
0010            DIMENSION HSTOR(2),HXSIDE(2)
0011            INCLUDE'UNPACK.CMN'
0012     1 ********************************************************
0013     1      INTEGER*4 HSIDE(6) ! CONNECTIVITY CODES IN    *
0014     1                         ! NUMERICAL ORDER BY SIDE *
0015     1      COMMON/UNPACK/HSIDE
0016     1 ********************************************************
0017            HXSIDE(1)=HXADD(HSTOR(2),HXINV(HSTOR(1)))
0018            HXSIDE(2)=HXINV(HXSIDE(1))
0019            LU=7
0020            DO J=1,2
0021              CALL HEXREAD(HSTOR(J),SIDES,LU)
0022              CALL UNPACKER(SIDES)
0023              CALL STRIPPER(HXSIDE(J),ISIDE)
0024              HSIDE(ISIDE)=LTYPE
0025              NEWSIDE=0
0026              DO I=1,6
0027                 NEWSIDE=NEWSIDE+HSIDE(I)*10**(I-1)
0028              ENDDO
0029              CALL HEXWRITE(HSTOR(J),NEWSIDE,LU)
0030            ENDDO
0031            RETURN
0032            END
```

```
0001            SUBROUTINE RIJ2IJ(RI,RJ,I,J)
0002      C     *ROUTINE(CONVERT REAL TO NEAREST INTEGER I,J COORDINATES - RIJ2IJ)
0003      C     ************************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  17 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       RIJ2IJ TAKES A POINT SPECIFIED BY REAL-VALUED OBLIQUE
0009      C     *       COORDINATES (RI,RJ) AND DETERMINES THE NEAREST POINT WITH
0010      C     *       INTEGER-VALUED OBLIQUE COORDINATES (I,J).  ALL TIES ARE
0011      C     *       RESOLVED IN FAVOR OF THE POINT WITH THE LARGER I AND/OR J
0012      C     *       COORDINATE.
0013      C     *       THE SYSTEM OF INTEGER I,J OBLIQUE COORDINATES CORRESPONDS
0014      C     *       TO THE SET OF HEX CENTERS IN A HEXAGONAL GRID.  WHEN COM-
0015      C     *       PUTATIONS ON SUCH A GRID LEAD TO POINTS OTHER THAN HEX
0016      C     *       CENTERS, IT IS OFTEN NECESSARY TO DETERMINE WHICH HEX CON-
0017      C     *       TAINS THE COMPUTED POINT.  THE HEX CONTAINING THE POINT IS
0018      C     *       THE ONE WHOSE CENTER IS CLOSEST TO THE POINT.  THUS THE
0019      C     *       PROBLEM REDUCES TO FINDING THE POINT WITH INTEGER I,J
0020      C     *       COORDINATES WHICH IS CLOSEST TO A GIVEN POINT WITH REAL
0021      C     *       I,J COORDINATES.  BECAUSE THE AXES IN THE OBLIQUE COORDI-
0022      C     *       NATE SYSTEM ARE NOT ORTHOGONAL, IT IS NOT ALWAYS CORRECT
0023      C     *       TO SIMPLY ROUND THE REAL I AND J COORDINATES TO THE NEAR-
0024      C     *       EST INTEGERS.  RIJ2IJ IMPLEMENTS THE PROPER TRANSFORMATION.
0025      C     *       GIVEN RI AND RJ, THE ALGORITHM FIRST FINDS THE GREATEST
0026      C     *       INTEGERS LESS THAN OR EQUAL TO THEM, NAMELY IO AND JO.
0027      C     *       THIS DETERMINES A RHOMBUS CONTAINING (RI,RJ) WITH VERTICES
0028      C     *       (IO,JO), (IO+1,JO), (IO+1,JO+1), AND (IO,JO+1).  IN ORDER
0029      C     *       TO DECIDE WHICH VERTEX IS CLOSEST TO (RI,RJ), THE RHOMBUS
0030      C     *       IS DIVIDED INTO BANDS OF WIDTH 1/2 PERPENDICULAR TO THE
0031      C     *       I, J, AND K AXES.  THERE ARE THREE I-BANDS NUMBERED 0, 1,
0032      C     *       AND 2 IN THE DIRECTION OF THE POSITIVE I-AXIS.  LIKEWISE,
0033      C     *       THERE ARE THREE J-BANDS.  THERE ARE ONLY 2 K-BANDS NUM-
0034      C     *       BERED 0 AND 1 IN THE DIRECTION OF THE NEGATIVE K-AXIS.
0035      C     *       ONCE THE I, J, AND K BAND NUMBERS FOR (RI,RJ) HAVE BEEN
0036      C     *       COMPUTED, THE COORDINATES (I,J) OF THE PROPER VERTEX ARE
0037      C     *       GIVEN BY:
0038      C     *             I = IO + (IBAND+KBAND)/2
0039      C     *             J = JO + (JBAND+KBAND)/2
0040      C     *    CALLING SEQUENCE:
0041      C     *       CALL RIJ2IJ(RI,RJ,I,J)
0042      C     *    INPUT:
0043      C     *       RI      - REAL-VALUED I COORDINATE
0044      C     *       RJ      - REAL-VALUED J COORDINATE
0045      C     *    OUTPUT:
0046      C     *       I       - INTEGER-VALUED I COORDINATE
0047      C     *       J       - INTEGER-VALUED J COORDINATE
0048      C     *
0049      C     ************************************************************************
0050            IMPLICIT INTEGER(H,P)
0051      C       *COMPUTE GREATEST INTEGERS LE RI AND RJ
0052              IO = IFIX(RI)
0053              JO = IFIX(RJ)
0054              IF(RI.LT.FLOAT(IO)) IO = IO - 1
0055              IF(RJ.LT.FLOAT(JO)) JO = JO - 1
0056      C       *FIND NONNEGATIVE FRACTIONAL PARTS OF RI AND RJ
0057              FI = RI - FLOAT(IO)
```

```
0058              FJ = RJ - FLOAT(J0)
0059      C      *COMPUTE I, J, AND K BAND NUMBERS
0060              IBAND = IFIX(FI + FI - FJ + 1.0)
0061              JBAND = IFIX(FJ + FJ - FI + 1.0)
0062              KBAND = IFIX(FI + FJ)
0063      C      *DETERMINE NEAREST INTEGER OBLIQUE COORDINATES
0064              I = I0 + ISHFT(IBAND+KBAND,-1)
0065              J = J0 + ISHFT(JBAND+KBAND,-1)
0066      C     *ENDROUTINE(RIJ2IJ)
0067              RETURN
0068              END
```

```
0001                SUBROUTINE SETGEO
0002        ************************************************************
0003        *       THIS ROUTINE SETS THE GEOGRAPHIC PARAMETERS        *
0004        *       NEEDED TO RUN THE LAT/LON-->UTM STUFF.             *
0005        ************************************************************
0006                INCLUDE 'CMERID.CMN'
0007   1    ************************************************************
0008   1                REAL*8 CMERID
0009   1                REAL P_RAD
0010   1                COMMON/CMERID/CMERID,P_RAD
0011   1    ************************************************************
0012                INCLUDE 'UTIL:ZDBPRO.CMN'
00100      0013   1 C
00200      0014   1 C       DUMMY COMMON ZDBPRO
00300      0015   1 C
00400      0016   1         INTEGER*4 ZRFDAY,ZIDCNT,ZYDOG,ZTSEC(4),ZTEX(5)
00500      0017   1         INTEGER*2 ZSPHID,ZYGOAT,ZTSN,ZRGN,ZRGL,ZMGRST(3,3),ZLLST(56)
00600      0018   1         LOGICAL*1 ZTSIC(3),ZTDWN(25)
00700      0019   1 C
00800      0020   1         COMMON /ZDBPRO/ ZRFDAY,ZIDCNT,ZYDOG,ZTSEC,ZTEX,
00900      0021   1        2                ZSPHID,ZYGOAT,ZTSN ,ZRGN ,ZTSIC,
01000      0022   1        3                ZTDWN ,ZRGL  ,ZMGRST,ZLLST
01100      0023   1 C
           0024                 PARAMETER PI=3.141592654
           0025                 P_RAD=PI/180.
           0026                 ZSPHID=1 ! INTERNATIONAL SPHEROID (?)
           0027                 ZRGN=32  ! UTM ZONE FOR MOST OF EUROPE
           0028                 CALL ADSCCM(ZRGN,CMERID) ! SET CENTRAL MERIDIAN
           0029                 CALL ADSSSP(ZSPHID)      ! SET SPHEROID IN ADCEAR.CMN
           0030                 END
```

```
0001            SUBROUTINE STRIPPER(HSIDE,ISIDE)
0002      C*****************************************
0003      C*****  THIS ROUTINE ACCEPTS A HEX VECTOR IN
0004      C*****  INTERNAL FORMAT,CONVERTS IT TO EXTERNAL
0005      C*****  FORMAT AND THEN STRIPS OFF THE LEADING
0006      C*****  7'S.
0007      C*****************************************
0008      C*****  INPUT:  HSIDE--THE HEX SIDE IN INTERNAL
0009      C*****                 FORMAT
0010      C*****  OUTPUT: ISIDE--THE HEX SIDE AS A DECIMAL
0011      C*****                 DIGIT
0012      C*****************************************
0013      C
0014            IMPLICIT INTEGER(H,P)
0015      C
0016            PARAMETER H7=77777770
0017      C*****  CONVERT THE INTERNAL HEX # TO DECIMAL
0018            CALL HEXOUT(HSIDE,1,ISIDE)
0019            ISIDE=ISIDE-H7
0020            RETURN
0021            END
```

```
0001            SUBROUTINE TRACE (IX,IY,IENTER,ITOP,HEIGHT,MASK,
0002           $    XYDELTA,ILL,IUR,JLL,JUR,IJDELTA)
0003      ************************************************************************
0004      *        TRACES CONTOUR UNTIL WINDOW EDGE OR CLOSURE.                  *
0005      *        CONTOUR ENTERED RES. ELEMENT "IX,IY" FROM SIDE "IENTER"       *
0006      ************************************************************************
0007      *        INPUTS:                                                       *
0008      *              IX,IY-- INDICES OF CURRENT RESOLUTION ELEMENT           *
0009      *              IENTER-- THE SIDE OF THE ELEMENT ENTERED (1,2,OR 3)     *
0010      *              ITOP -- A FLAG (0 UPON ENTRY) WHETHER THE Y INDEX HAS   *
0011      *                      REACHED THE "TOP" OF THE ARRAY                  *
0012      *            HEIGHT-- THE ALTITUDE OF THE TRACE                        *
0013      *            MASK-- AN ARRAY OF FLAGS INIDCATING THE STATUS OF EACH    *
0014      *                   SIDE OF EACH ELEMENT (0-NOT CHECKED,               *
0015      *                   1-INTERCEPT,10-NO INTERCEPT)                       *
0016      *            XYDELTA-- HORIZONTAL DISTANCE BETWEEN CONTOUR INTERVAL    *
0017      *                      CHECKS                                          *
0018      *            ILL,IUR-- LOWER LEFT AND UPPER RIGHT LIMITS TO THE ROW    *
0019      *                      INDEX                                           *
0020      *            JLL,JUR-- SAME FOR THE COLUMN INDEX                       *
0021      *            IJDELTA-- RATIO OF THE CONTOUR ELEMENTS TO THE DATA       *
0022      *                      ELEMENTS                                        *
0023      *        OUTPUTS: NONE                                                 *
0024      *        ***  H.JONES ***                                              *
0025      ************************************************************************
0026            IMPLICIT INTEGER*2 (I-N)
0027              INCLUDE 'MASK.DIM'
0028     1 ************************************************************
0029     1        BYTE MASK(400,400,3)
0030     1 ************************************************************
0031       C
0032           10 CONTINUE
0033              IF(IX .LT. ILL .OR. IX .GT. IUR) THEN
0034                 GO TO 20
0035              ENDIF
0036              IF(IY .LT. JLL .OR. IY .GT. JUR) THEN
0037                 GO TO 20
0038              ENDIF
0039       C
0040              IF(IENTER .NE. 1) THEN
0041                 IF(ITOP .EQ. 0) THEN
0042                    IYIND = IY
0043                 ELSE
0044                    IYIND = IY+IJDELTA
0045                 ENDIF
0046                 IF(MASK(IX,IYIND,1) .EQ. 0) THEN
0047                       CALL INTERS(IX,IYIND,IX+
0048            $          IJDELTA,IYIND,HEIGHT,FRAC,ICROSS)
0049                    IF(ICROSS .EQ. 1) THEN
0050                       X=FLOAT(IX/IJDELTA)*XYDELTA
0051                       XX = X + XYDELTA * FRAC
0052                       YY=FLOAT(IYIND/IJDELTA)*XYDELTA
0053 C   D                  CALL CMCLOS
0054 C   D                  PRINT*,XX,YY,'      TRACE'
0055 C   D                  CALL CMOPEN
0056                       CALL DRAW (XX,YY)
0057                       MASK(IX,IYIND,1) = 1
```

TRACE

```
0058                    IY = IYIND - IJDELTA + ITOP*IJDELTA
0059                    IENTER = 1
0060                    ITOP = 1 - ITOP
0061                    GO TO 10
0062                 ELSE
0063                    MASK(IX,IYIND,1) = 10
0064                 ENDIF
0065              ENDIF
0066           ENDIF
0067     C
0068           IF(IENTER .NE. 2) THEN
0069              IF(ITOP .EQ. 0) THEN
0070                 IXIND = IX
0071              ELSE
0072                 IXIND = IX+IJDELTA
0073              ENDIF
0074              IF(MASK(IXIND,IY,2) .EQ. 0) THEN
0075             CALL INTERS(IXIND,IY,IXIND,IY+
0076          +  IJDELTA,HEIGHT,FRAC,ICROSS)
0077                 IF(ICROSS .EQ. 1) THEN
0078                    XX=FLOAT(IXIND/IJDELTA)*XYDELTA
0079                    Y=FLOAT(IY/IJDELTA)*XYDELTA
0080                    YY = Y + XYDELTA * FRAC
0081                    CALL DRAW (XX,YY)
0082                    MASK(IXIND,IY,2) = 1
0083                    IX = IXIND - IJDELTA + ITOP*IJDELTA
0084                    IENTER = 2
0085                    ITOP = 1 - ITOP
0086                    GO TO 10
0087                 ELSE
0088                    MASK(IXIND,IY,2) = 10
0089                 ENDIF
0090              ENDIF
0091           ENDIF
0092     C
0093           IF(IENTER .NE. 3 .AND. MASK(IX,IY,3) .EQ. 0) THEN
0094             CALL INTERS(IX,IY+IJDELTA,IX+
0095          $  IJDELTA,IY,HEIGHT,FRAC,ICROSS)
0096              IF(ICROSS .EQ. 1) THEN
0097                 X=FLOAT(IX/IJDELTA)*XYDELTA
0098                 Y=FLOAT(IY/IJDELTA+1)*XYDELTA
0099                 XX = X + XYDELTA * FRAC
0100                 YY = Y - XYDELTA * FRAC
0101                 CALL DRAW (XX,YY)
0102                 MASK(IX,IY,3) = 1
0103     C
0104                 IENTER = 3
0105                 ITOP = 1 - ITOP
0106                 GO TO 10
0107              ELSE
0108                 MASK(IX,IY,3) = 10
0109              ENDIF
0110           ENDIF
0111     C
0112        2  RETURN
0113           END
```

```
0001              FUNCTION TRANX(X)
0002        C
0003        C     TRANSLATES THE X VALUES STORED IN THE NODE AND
0004        C     SUBNODE RECORDS OF THE BDM DATA FILES BACK TO
0005        C     STANDARD UTM COORDINATES.THE STORED DATA HAS HAD
0006        C     500,000M SUBTRACTED AND BEEN DIVIDED BY 20,SO...
0007              INTEGER*2 X
0008              X1=X
0009 C   D        CALL CMCLOS
0010        C
0011              TRANX=20*X1+500000
0012 C   D        PRINT*,'X',X,TRANX
0013 C   D        CALL CMOPEN
0014              RETURN
0015              END
```

```
0001              FUNCTION TRANY(Y)
0002         C
0003         C    TRANSLATES THE Y VALUES STORED IN THE NODE AND
0004         C    SUBNODE RECORDS OF THE SDM DATA FILES BACK TO
0005         C    STANDARD UTM COORDINATES.THE STORED DATA HAS HAD
0006         C    5,600,0004 SUBTRACTED AND BEEN DIVIDED BY 20,SO...
0007         C
0008              INTEGER*2 Y
0009              Y1=Y
0010              TRANY=20*Y1+5600000
0011 C   D        CALL CMCLOS
0012 C   D        PRINT*,'Y',Y,TRANY
0013 C   D        CALL CMOPEN
0014              RETURN
0015              END
```

```
0001            SUBROUTINE UNGEN
0002      ************************************************
0003      *       THIS ROUTINE GENERATES THE FILE NAMES AND  *
0004      *       RELATIVE INDICES FOR PLACING THE FILE      *
0005      *       DATA INTO THE ARRAY IBUF.                  *
0006      ************************************************
0007            INCLUDE 'CORNER.CMN'
0008    1 ************************************************************
0009    1 *       SWX,SWY ARE THE SOUTHWEST UTM COORDINATES OF THE  *
0010    1 *       AREA IN THE ARRAY IBUF.                           *
0011    1       INTEGER*4 SWX,SWY
0012    1       COMMON/CORNER/SWX,SWY
0013    1 ************************************************************
0014            CHARACTER*7 MGR
0015            LOGICAL*1 ERR
0016            DO J=0,3
0017               IEAST=SWX+J*10000
0018               DO I=0,3
0019                  NORTH=SWY+I*10000
0020                  CALL UTM2MGR(IEAST,NORTH,MGR,ERR)
0021                  CALL MAPIN(I,J,MGR,ERR)
0022               ENDDO
0023            ENDDO
0024            RETURN
0025            END
```

```
0001            SUBROUTINE UNPACKER(SIDES)
0002      C*****************************************
0003      C*****  THIS ROUTINE IS DESIGNED TO UNPACK
0004      C*****  THE CONNECTIVITY CODES FROM THE DATA
0005      C*****  IN THE ISAM FILE CREATED BY ROADHEXER.
0006      C*****************************************
0007      C*****  INPUT:  SIDES--THE PACKED CONNECTIVITY
0008      C*****                 CODES
0009      C*****  OUTPUT: HSIDE(6)--THE UNPACKED CONNEC-
0010      C*****                    TIVITY CODES
0011      C*****************************************
0012      C
0013            IMPLICIT INTEGER (H,P)
0014            INTEGER*4 SIDES
0015            INCLUDE 'UNPACK.CMN'
0016    1 ********************************************************
0017    1       INTEGER*4 HSIDE(6) ! CONNECTIVITY CODES IN    *
0018    1                          ! NUMERICAL ORDER BY SIDE *
0019    1       COMMON/UNPACK/HSIDE
0020    1 ********************************************************
0021      C
0022      C     IN ORDER TO AVOID CHANGING 'SIDES'
0023            ISIDES=SIDES
0024            DO I=6,1,-1
0025               IEXP=10**(I-1)
0026               HSIDE(I)=INT(ISIDES/IEXP)
0027               ISIDES=ISIDES-HSIDE(I)*IEXP
0028            ENDDO
0029            RETURN
0030            END
```

```
0001            SUBROUTINE XY2IJM(X,Y,I,J)
0002      C     *ROUTINE(CONVERT X,Y TO MIN LEVEL I,J COORDINATES - XY2IJM)
0003      C     ************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KNECKER  20 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       XY2IJM CONVERTS A PAIR OF X,Y CARTESIAN COORDINATES EX-
0009      C     *       PRESSED IN METERS TO I,J OBLIQUE COORDINATES AT THE MINI-
0010      C     *       MUM HEX LEVEL.  THE RESULT IS THE PAIR OF INTEGER-VALUED
0011      C     *       I,J COORDINATES CORRESPONDING TO THE CENTER OF THE MINIMUM
0012      C     *       LEVEL HEX WHICH CONTAINS THE GIVEN POINT.  THIS ROUTINE IS
0013      C     *       THE INVERSE OF THE SUBROUTINE IJM2XY.
0014      C     *       THE CONVERSION IS CARRIED OUT BY FIRST APPLYING A LINEAR
0015      C     *       TRANSFORMATION (IN THE FORM OF A MATRIX MULTIPLICATION) TO
0016      C     *       THE X,Y VECTOR TO OBTAIN A PAIR OF REAL-VALUED I,J COORDI-
0017      C     *       NATES.  THE RESULT IS THEN ROUNDED TO THE NEAREST INTEGER-
0018      C     *       VALUED I,J COORDINATES BY THE ROUTINE RIJ2IJ.
0019      C     *    CALLING SEQUENCE:
0020      C     *       CALL XY2IJM(X,Y,I,J)
0021      C     *    INPUT:
0022      C     *       X,Y     - REAL-VALUED CARTESIAN COORDINATES EXPRESSED IN
0023      C     *                 METERS WHICH ARE TO BE CONVERTED TO OBLIQUE COOR-
0024      C     *                 DINATES AT THE MINIMUM HEX LEVEL
0025      C     *       RIOFX   - REAL I COORDINATE OF THE VECTOR (X,Y) = (1,0).
0026      C     *                 (IN COMMON/HEX/)
0027      C     *       RJOFX   - REAL J COORDINATE OF THE VECTOR (X,Y) = (1,0).
0028      C     *                 (IN COMMON/HEX/)
0029      C     *       RIOFY   - REAL I COORDINATE OF THE VECTOR (X,Y) = (0,1).
0030      C     *                 (IN COMMON/HEX/)
0031      C     *       RJOFY   - REAL J COORDINATE OF THE VECTOR (X,Y) = (0,1).
0032      C     *                 (IN COMMON/HEX/)
0033      C     *    OUTPUT:
0034      C     *       I,J     - INTEGER-VALUED OBLIQUE COORDINATES CORRESPONDING
0035      C     *                 TO THE CENTER OF THE MINIMUM LEVEL HEX CONTAINING
0036      C     *                 THE GIVEN X,Y POINT
0037      C     *
0038      C     ************************************************************
0039            IMPLICIT INTEGER(H,P)
0040            COMMON/HEX/IHXOUT,NHLEV,MINLEV,SLTO,CLTO,OLNO,DIAM(10),DIAMT
0041           $R,
0042           +                 XOFI,YOFI,XOFJ,YOFJ,RIOFX,RJOFX,RIOFY,RJOFY,
0043           +                 ICON(70),JCON(70),IMAX(7),JMAX(7)
0044            DIMENSION IVAL(7),JVAL(7)
0045            EQUIVALENCE(IVAL(1),ICON(1)),(JVAL(1),JCON(1))
0046      C       *TRANSFORM X,Y COORDINATES TO EQUIVALENT REAL-VALUED I,J PAIR
0047              RI = RIOFX * X + RIOFY * Y
0048              RJ = RJOFX * X + RJOFY * Y
0049      C       *INCLUDE(CONVERT REAL I,J COORDINATES TO INTEGER - RIJ2IJ)
0050              CALL RIJ2IJ(RI,RJ,I,J)
0051      C     *ENDROUTINE(XY2IJM)
0052            RETURN
0053            END
```

```
0001            SUBROUTINE XYL2HA(X,Y,LEV,HADR)
0002      C     *ROUTINE(CONVERT X,Y COORDINATES AND LEVEL TO HEX ADDRESS-XYL2HA)
0003      C     ***************************************************************
0004      C     *
0005      C     *    DESIGNER/PROGRAMMER:
0006      C     *       DON KRECKER  21 SEPTEMBER 1980
0007      C     *    PURPOSE:
0008      C     *       XYL2HA TAKES A POINT EXPRESSED IN X,Y CARTESIAN COORDINATES
0009      C     *       IN METERS AND COMPUTES THE ADDRESS OF THE HEX AT THE SPECI-
0010      C     *       FIED LEVEL WHICH CONTAINS THE POINT.  IF THE SPECIFIED HEX
0011      C     *       LEVEL IS GREATER THAN THE MINIMUM HEX LEVEL, THE COMPUTED
0012      C     *       HEX MAY DIFFER FROM THE HEX (AT THIS LEVEL) WHOSE CENTER IS
0013      C     *       CLOSEST TO THE GIVEN POINT.  THE REASON IS THAT HEXES AT
0014      C     *       HIGHER LEVELS OF AGGREGATION ARE NOT TRUE REGULAR HEXAGONS
0015      C     *       BUT ONLY APPROXIMATE REGULAR HEXAGONS IN SHAPE.  XYL2HA IS
0016      C     *       THE INVERSE OF THE SUBROUTINE HA2XYL, WHICH CONVERTS A HEX
0017      C     *       ADDRESS TO THE X,Y COORDINATES OF THE CENTER OF THE HEX.
0018      C     *       XYL2HA FIRST CALLS THE ROUTINE XY2IJM TO CONVERT THE X,Y
0019      C     *       COORDINATES TO I,J OBLIQUE COORDINATES AT THE MINIMUM HEX
0020      C     *       LEVEL.  THEN THE FUNCTION IJM2HA IS USED TO CONVERT THE I,J
0021      C     *       COORDINATES TO A HEX ADDRESS AT THE REQUESTED LEVEL.  ERROR
0022      C     *       CHECKING IS DONE BY THIS SUBORDINATE FUNCTION.
0023      C     *    CALLING SEQUENCE:
0024      C     *       CALL XYL2HA(X,Y,LEV,HADR)
0025      C     *    INPUT:
0026      C     *       X,Y     - REAL-VALUED CARTESIAN COORDINATES EXPRESSED IN
0027      C     *                 METERS OF A POINT WHOSE CONTAINING HEX AT A SPE-
0028      C     *                 CIFIED LEVEL IS TO BE COMPUTED
0029      C     *       LEV     - LEVEL OF AGGREGATION OF THE HEX ADDRESS TO BE
0030      C     *                 COMPUTED
0031      C     *    OUTPUT:
0032      C     *       HADR    - ADDRESS OF THE HEX AT THE REQUESTED LEVEL WHICH
0033      C     *                 CONTAINS THE GIVEN X,Y POINT
0034      C     *
0035      C     ***************************************************************
0036            IMPLICIT INTEGER(H,P)
0037      C       *INCLUDE(CONVERT X,Y TO MIN LEVEL I,J COORDINATES - XY2IJM)
0038              CALL XY2IJM(X,Y,I,J)
0039      C       *INCLUDE(CONVERT MIN LEVEL I,J AND LEVEL TO HEX ADDRESS-IJM2HA)
0040              HADR = IJM2HA(I,J,LEV)
0041      C     *ENDROUTINE(XYL2HA)
0042            RETURN
0043            END
```

APPENDIX C

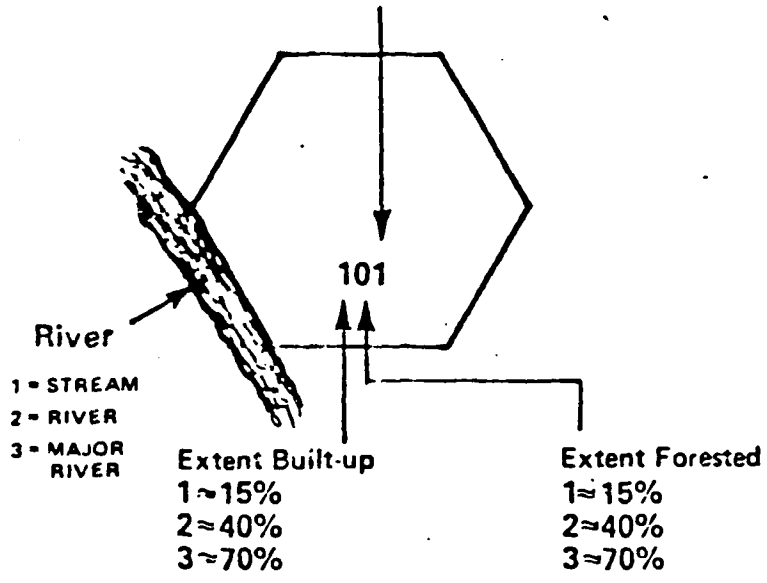
HEX DATA IN ICOR

Appendix C - Hexagonal Terrain in ICOR.

The following information was excerpted from the ICOR User's Manual published by BDM.

HEX Terrain Codes

Terrain Roughness
1 = terrain slope avg>.03 overall or≈15% hills or rugged terrain
2 = terrain slope avg>.06 overall or≈40% hills or very rugged terrain
3 = terrain slope avg>.1 or most of hex impassable to vehicles



Roads:
Roads do not always correspond one to one with actual highways, but rather indicate the extent to which two hexes are connected.

Autobahn: ═══ 3
Primary: ——— 2
Secondary: — — — 1

Figure C-1

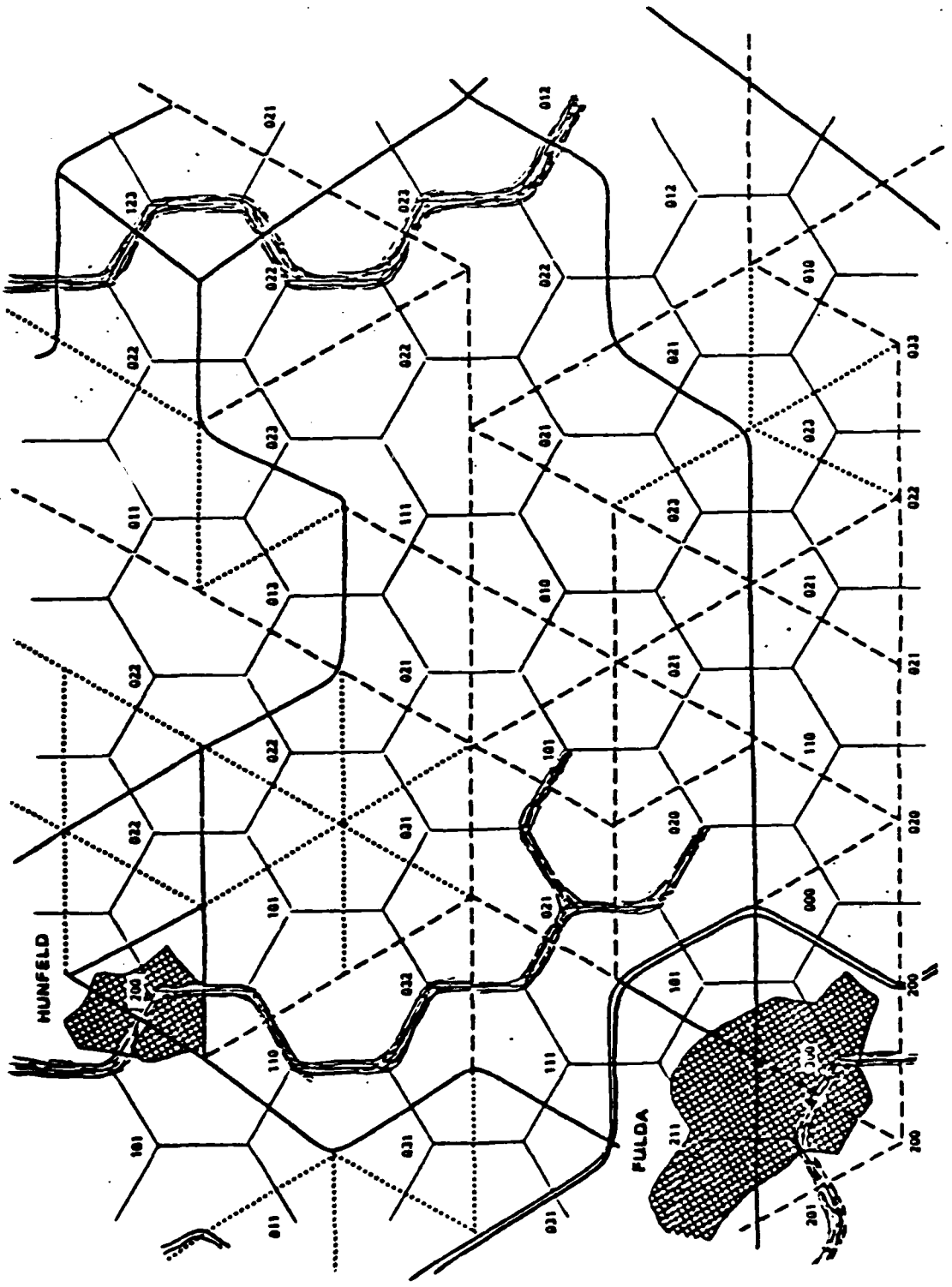


Figure C-2

Sample ICOR Terrain

THE HEXAGONAL COORDINATE SYSTEM

In the ICOR simulation the plane, or surface of the earth on which units move and fight, is broken up into discrete points as a means of organizing the data base and the operation of the model. Thus, it is possible to refer to all units and terrain as being at a particular location, meaning in the neighborhood of a given discrete point. This allows the locations of units and terrain features to be represented in the model much more compactly than would be possible if they were represented, for example, as a floating point coordinate pair on a cartesian plane along with given shapes. More important, the discrete points provide a means of reference as in the expression "all units at location X". Thus, each point can be represented in the computer as a block in a data structure, which contains terrain information about the neighborhood at that point, and a list of units in that neighborhood.

A hexagonal grid has been chosen as a means of defining the points, or neighborhoods, so represented. This has several advantages. The most important is that in a hexagonal grid, any neighborhood, or hexagon, which is adjacent to another also shares a side of finite length. This is not true with a square grid, where neighborhoods can be adjacent at a corner. This eliminates the tactical problem of a unit moving diagonally between two adjacent enemy units, without entering the neighborhood of either. If this problem is eliminated in a square grid by disallowing diagonal movement, then it restricts movement direction choice to only four directions, requiring units to move up to 45° off of their desired direction, with a loss of 29% of their effective speed. In a hexagonal grid the corresponding maximum loss is 13%. A hexagonal grid also eliminates complications from the two types of adjacencies when evaluating a situation, choosing movement direction, and calculating speed and arrival time at the next location. Another benefit is that a locus of points at a given count of hexes away from a center hex more closely approximates a circle than a similar locus on a square grid. This allows distance considerations, such

as the range of artillery, to be expressed as a given number of hexes. With a square grid such a procedure would introduce unacceptable errors.

One ultimate goal in a modeling system, of which ICOR is but one member, is the provision for scale change of the system to different levels of detail. It is possible with a hexagonal grid to divide each neighborhood into seven smaller neighborhoods which, when this is done for all hexes, creates a new hexagonal grid of smaller hexes. Conversely, groups of seven hexes can be grouped together to form larger hexes. Figure B-1 illustrates. For each level of aggregation, the size (diameter) of the next larger hex is $\sqrt{7}$ times that of the smaller hexes. The axis of straight rows, or the "grain" of the hex field, rotates approximately 19° counterclockwise. In the BDM hexagonal system, levels of hexes are defined as shown in Figure B-2. The size hex used for the units in ICOR is level 4, or 3.57 Km diameter (and center to center).

A numbering scheme for hexes must define the level of the hex, and its position in the plane of hexes at that level. In the BDM hex numbering system, the level of the hex is equal to 12 minus the number of digits in the hex address. Thus, a single digit hex address is a level 11 hex of 3,241 Km diameter. A two digit hex adds resolution of an additional level, to 1225 km. In ICOR, the 8 digit hex numbers, or addresses, give 8 levels of resolution, which corresponds to level 4, or 3.57 km hexes.

As a hex address is read from left to right one reads from most significant to least significant digit. At each digit, one can consider a selection of a smaller hex within the larger, or higher level, hex given by the preceeding digits. Figure B-3 illustrates this disaggregation.

At each level, a single digit represents the seven possible smaller hexes, and corresponding directions. These directions are shown in Figure B-4. If the digit is considered to be an octal number of three bits, each bit equal to one indicates a one hex diameter vector in the i, j, or k directions. Thus the vectors in each of the three basic directions are 001 or 1 for i, 010 or 2 for j, and 100 or 4 for k. Other directions are represented by combinations. The combination 111 or 7 is used for the null vector rather than 0.

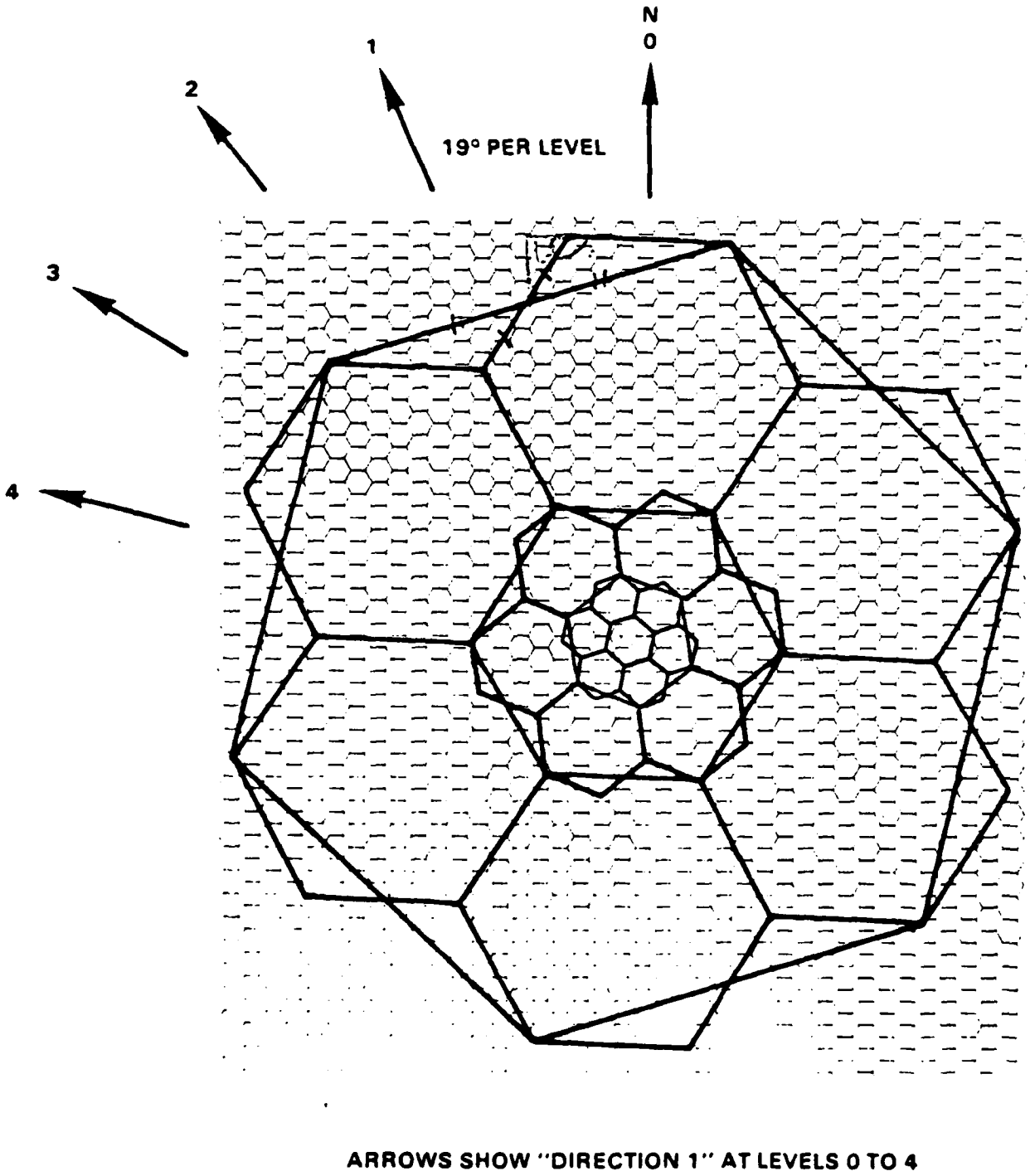


Figure C-3

Hexes of Levels 0 Through 4 (Detailed and Idealized Boundaries)

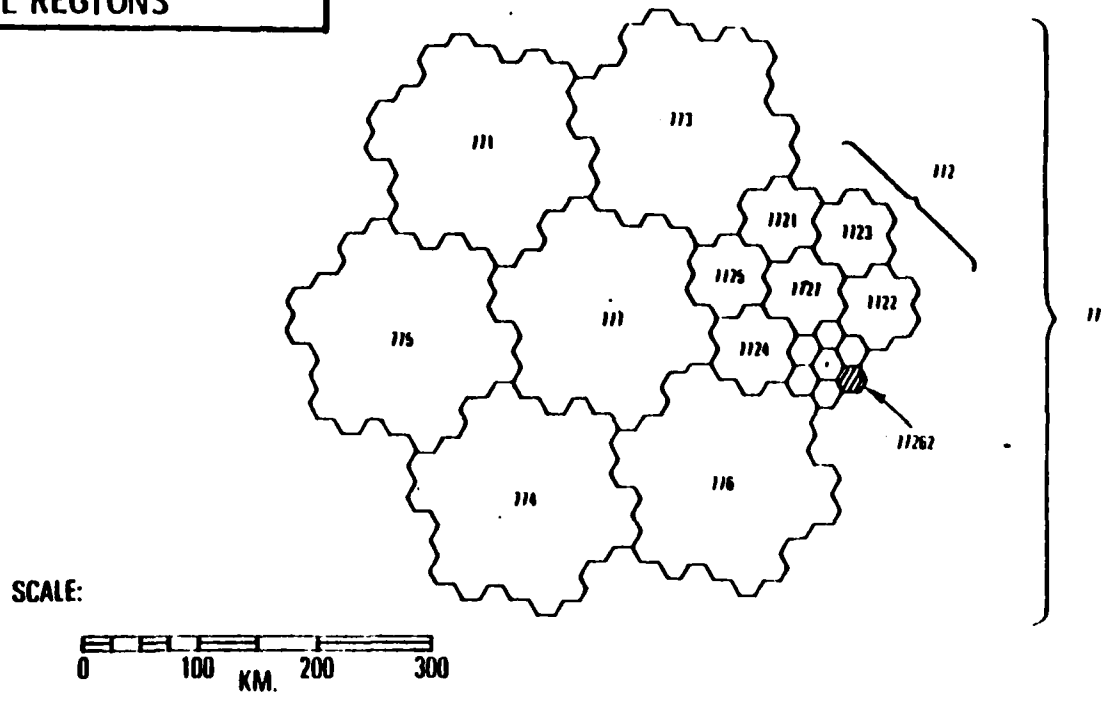
LEVEL	HEX DIAMETER	HEX AREA
0	72.9 M	4601 M^2
1	192.8 M	32205 M^2
2	510.2 M	225434 M^2
3	1.35 KM	1578035 M^2
4	3.57 KM	11.0 KM^2
5	9.45 KM	77.3 KM^2
6	25.00 KM	541.3 KM^2
7	66.14 KM	3788.9 KM^2
8	175.00 KM	26522 KM^2
9	463.01 KM	185654 KM^2
10	1225.00 KM	1299579 KM^2
11	3241.05 KM	9097056 KM^2
12	8575.00 KM	63679389 KM^2

Figure C-4

Hex Dimensions

HEX POSITION LOCATION SYSTEM

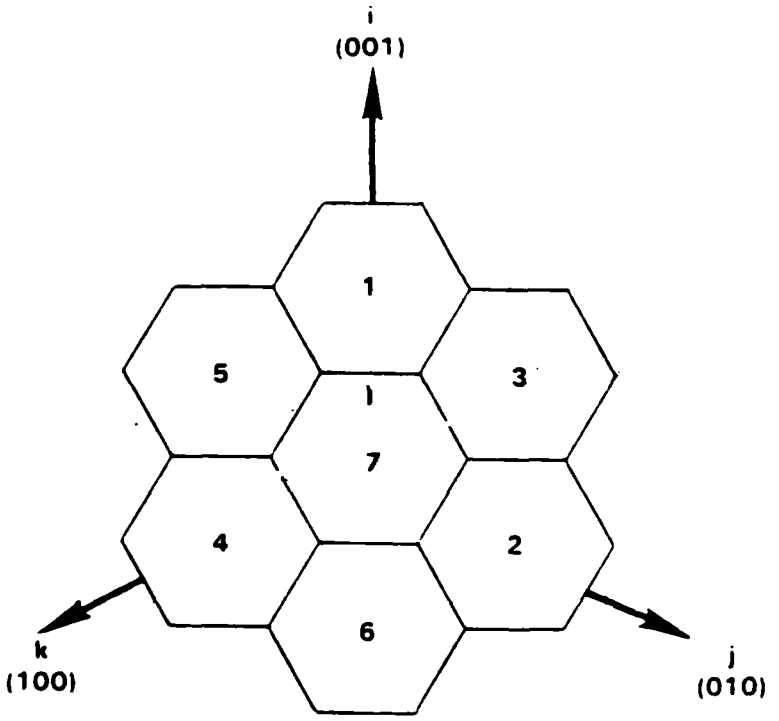
INTERNAL "COORDINATE SYSTEM" BASED ON NESTED HEXAGONAL REGIONS



- REALISTIC REPRESENTATION OF MANEUVER
- WIDER POSSIBILITIES FOR UNIT INTERACTIONS
- SIGNIFICANT COMPUTATIONAL EFFICIENCY

Figure C-5

Hex Position Location System



Hex Numbers and Directions at Level 4

Figure C-6

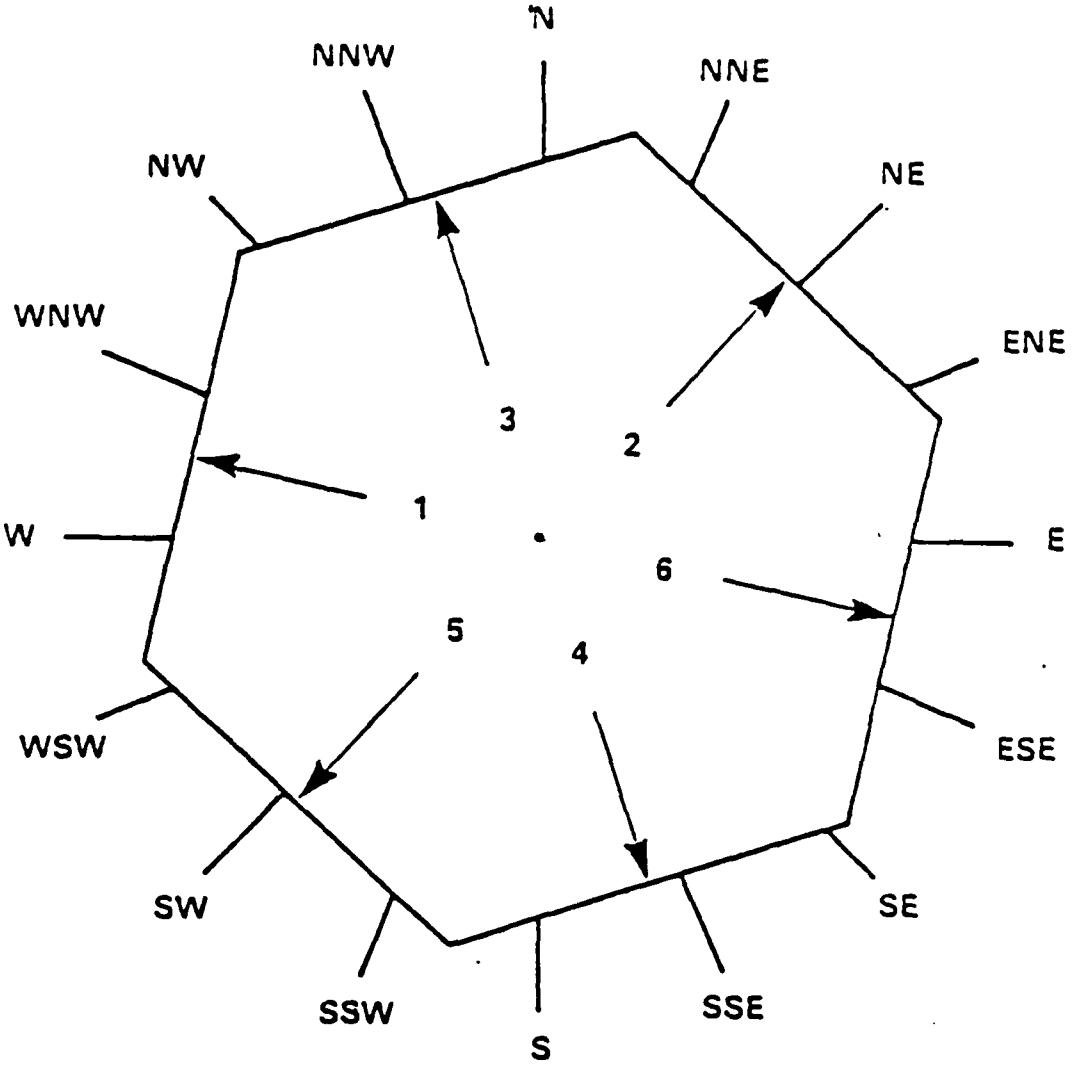
As a practical matter, a hex grid having hex addresses on it for cluster-center hexes but not others is usually used in the play of the ICOR simulation. There are two cases:

(1) In computer generated hex maps, the number given in the center hex is that of the higher level hex at the next level. To get the actual hex number, append 7 to the hex address of the center hex (in which the number is given). For each adjacent hex append the number for the given hex direction of that hex relative to the center hex (as shown in Figure B-5 for level 4).

(2) In some other manually-generated maps, the hex address of the center hex at the level of the hexes shown is given. This results in all hex addresses for center hexes ending in the digit 7. If this is the case, the hex address of each adjacent hex may be found by deleting the last 7 and appending the hex direction from the center hex to that hex.

The hex coordinate system used in the ICOR model is centered near the town of Fulda. The hex 7, and all hexes 7....7, are centered at 50°30'N, 9°30'E or NA3594 in UTM. If one starts with a blank (no addresses) hex sheet, the origin would then be labeled with the number 7....7 with the number of 7's indicating the level of hexes. Figure B-6 illustrates how all other hexes on the sheet can then be numbered. Summarizing, to plot a center hex at the given level, count hexes as follows:

Level	Hexes in Given Hex Direction	and Hexes to Left
Same	1	0
1 higher	2	1
2 higher	3	5
3 higher	1	18



Hex Directions at Level 4

Figure C-7

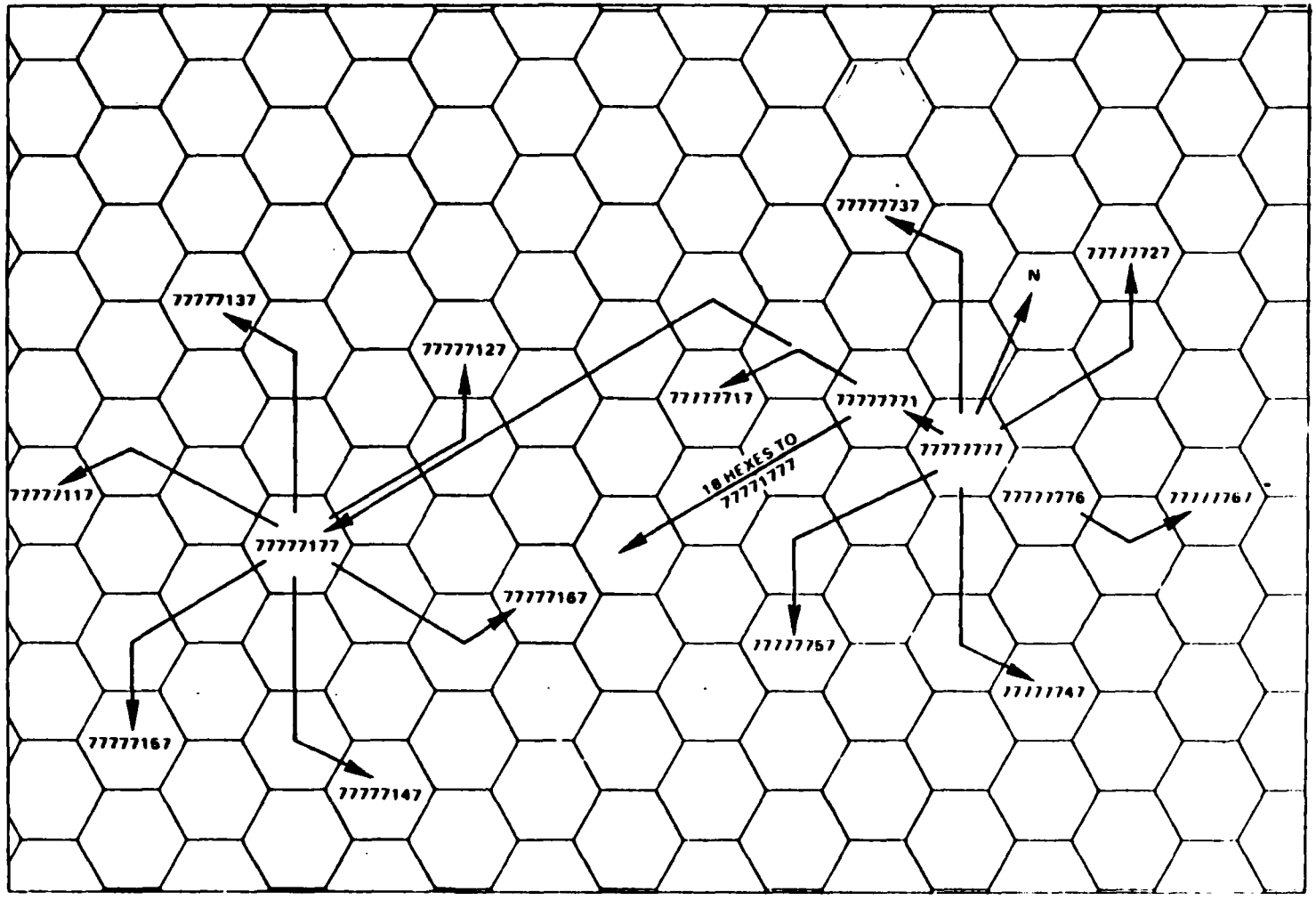


Figure C-8

Plotting Hex Numbers

APPENDIX D

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APPENDIX D

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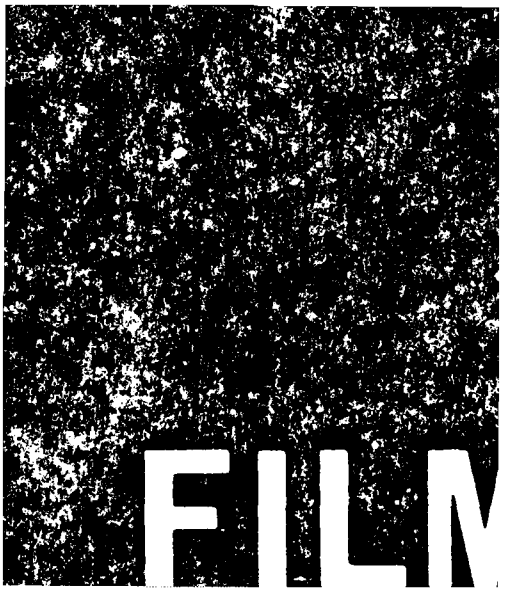
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